JPRS 77853

16 April 1961

East Europe Report

SCIENTIFIC AFFAIRS

No. 700

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 77853

16 April 1981

EAST EUROPE REPORT

SCIENTIFIC AFFAIRS

No. 700

CONTENTS

INTERNATIONAL AFFAIRS

New Computer Communications System Introduced in Czechoslovakia
(Jan Subert; ZEMEDELSKE NOVINY, 10 Feb 81) 1

Briefs
Medical Technology Exports 4

GERMAN DEMOCRATIC REPUBLIC

Toxicology Center Director Sees Need for Increased CW Research
(Karlheinz Lohs; NEUES DEUTSCHLAND, 5 Mar 81) ....

HUNGARY

Energy Consumption in Ferrous Metallurgy Viewed
(KOHASZAT, Jan 81) 8

Technological Situation, by Otto Farkas
The Plant Viewpoint, by Gellert Repasi

Relation of Materials to Technical Development Outlined
(Mihaly Stefan; MAGYAR TUDOMANY, Feb 81) 25

Control Problems of the Machine Industry
(Zsuzsa Szentgyorgyi; SZAMITASTECHNIKA, Dec 80) 35

Hungarian Speaking Computer in Laboratory Stage
(Gabor Kiss, Gabor Olaszy; SZAMITASTECHNIKA, Dec 80) 38

Holographic-Assisted Research in Analysis, Design of Disperse Systems
(MUSZAKI ELET, 20 Mar 81) 41

POLAND

Most Important Scientific Achievements Described
(ZYCIE WARSZAWY, 6 Jan 81) 43

NEW COMPUTER COMMUNICATIONS SYSTEM INTRODUCED IN CZECHOSLOVAKIA

Prague ZEMEDELSKE NOVINY in Czech 10 Feb 81 pp 1, 4

[Article by Jan Subert: "Computers Connected by Radio"]

[Text] Since last September a remarkable and unique invisible radio communications line has passed through the air above our capital. It is 9 kilometers long and stretches from the Computer Center of the Czechoslovak Academy of Sciences in Libna to the Institute of Geophysics in Sporilov. In this instance the complex transmitting and receiving equipment has a quite extraordinary task: it establishes two-way wireless communication between two independent computers at some distance from each other for the first time in the socialist countries.

Director of the Institute of Cybernetics in the Ukraine Academician Viktor Glushkov calculated some time ago that effective management of the current Soviet economy requires about 10 trillion computer operations a year. At the same time he calculated that if this task had to be taken over from the computers solely by mathematicians using slide rules, it would be necessary to put together an army of 30 million such persons.

Computers capable of carrying out hundreds of thousands or millions of operations every second are of course irreplaceable in other areas besides administration, labor organization and management of production processes. Their role is perhaps even more striking in scientific work and in research, which would be almost totally unable to proceed without their aid. It suffices to note, for example, that the amount of scientific and technical knowledge now doubles every 4 years.

The risk of an "information collapse," which could become an important drag on further research, and the effort to liberate science from a large quantity of everyday, routine work, are thus bringing into being an entirely new scientific field: automation of scientific research. One of its exponents, Eng Mirko Novak, Dr Sc, says of this field:

"Without exception, in the course of an extensive scientific experiment in which an interdisciplinary team of specialists such as a biochemist, a biologist, a physicist, a mathematician, an electronics engineer, a cyberneticist, a logician and many others participate, it is necessary to handle 100,000, 200,000 or a million numerical values. How are we to handle the data obtained and interpret them for man?"

"The main idea and aim of automating scientific research is accordingly that of providing the comprehensive information of all of the necessary data for further work, in the shortest time possible," explains Dr Novak. "Rapid, real-time processing of data can, for example, enable the scientist to influence and revise his experiment 'on the fly,' which in fact makes it possible to manage an experiment on a real-time basis. And this is an opportunity which we must attempt to utilize during this five-year plan.

Eng Mirko Novak, Dr Sc, is the director of the Computer Center, Czechoslovak Academy of Sciences, and the leader of the group which is engaged in creating an extensive computer network which in the future will unite the individual institutes of the Czechoslovak Academy of Sciences to a powerful computer center. Accordingly it is superfluous and financially burdensome to equip each scientific institute with a large, expensive computer. It is sufficient to create a single powerful central computer complex to which the less powerful computers in the individual research organizations can be connected.

On the basis of this simple idea, a wide variety of hierarchical computer complexes have been created abroad. Among these which connect groups of scientific institutes, those in Moscow, Riga and Novosibirsk are our models. But under our conditions, the problem of how to connect such a system has arisen.

Dr Novak says: "Our administration had to reject immediately the idea of using cables--as is done in the Soviet Union--in our capital, which has the largest concentration of scientific institutes. Given the current state of the Prague cable network, this would have been a fantasy. And thus we ultimately chose the simplest approach--which was also essentially the cheapest--that of wireless interconnection."

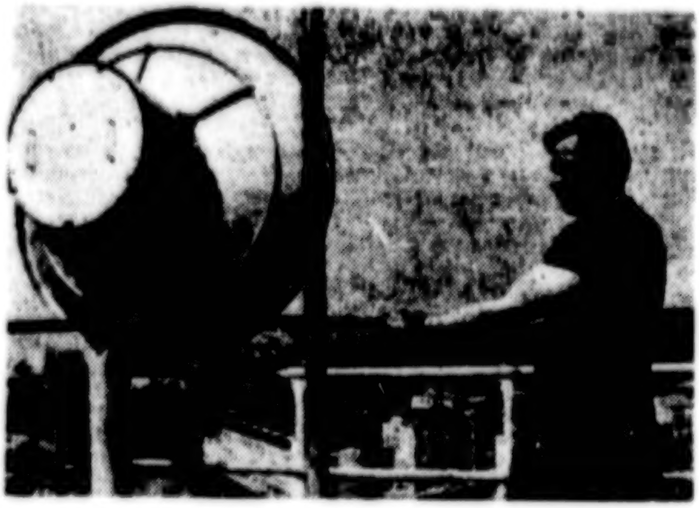
The wireless computer interconnection project got under way in the early 1970's. It received assistance from specialists at Tesla Hloubetin and their colleagues at Tesla Research Institute of Telecommunications. Tesla Strasnice and a group of specialists from the Research Institute of Telecommunications in Budapest also lent a hand. The team effort was rewarded by success last September. The system consists of a radio connection about 9 kilometers long between the EC 10101 computer in the Institute of Geophysics and the EC 1040 computer in the computer center.

Dr Novak continues: "By using the 36-meter antenna mast which is already in place at the institute of microbiology in Kec, we hope to establish communications with the computer center of the Institute of Astronomy in Andrejov, 40 kilometers distant, this eyar. During the Seventh Five-Year Plan, we would gradually include other CSAV organizations, for example in Rez, Prague-Suchdol, Praha na Petrinach and elsewhere. And in the long term--but in this case by cable--we would also like to establish communications with our institutes in Ceske Budejovice, Brno, Bratislava and Ostrava."

But in the meantime, we must considerably strengthen the computer center itself, whose single computer is already insufficient. Even though it is operating in three shifts, Dr Novak continues, "We are planning to install three or four more really powerful computers. But everything depends on the speed with which Armabeton in Prague makes our new building available. Thus far this enterprise has shown us exceptional understanding, but it is a question of its adhering to the agreed-upon schedule."

The unusual project of a radio-connected CSAV computer network stems from current tendencies toward concentration and integration, which are capable of producing the greatest possible economic effect. Thus it is no wonder that it has attracted considerable attention even outside our top scientific institute. The Institute of Hydrometerology in Bratislava has shown serious interest, and we have also heard from the Ministry of Power. And the Soviet Union appears to be going even further. The leaders of a complex of institutes of the USSR Academy of Sciences in Riga have already ordered receiving and transmitting equipment from Tesla Hloubetin for their own network.

The case of the Czechoslovak Academy of Sciences is also an example of highly efficient use of powerful, expensive computers, which we have already had much trouble using productively in our economy. In this area too, attentiveness and persistence are well worth while.



Before the end of this year, the radio link with the computer of the Institute of Geophysics will be added radio communication with the computer at the Institute of Astronomy in Ondrejob, which is about 40 kilometers away from the computer center in Libna. The aerial path uses a 36-meter mast with two parabolic antennas. One of these (shown in the photograph) is pointed toward Ondrejov and the other toward Libna.

8480
CSO: 2402

BRIEFS

MEDICAL TECHNOLOGY EXPORTS--The CHIRANA concern in Stara Tura, Slovakia, has been exporting medical technology to more than 60 countries. Traditionally, these exports go to the socialist countries, the FRG, Austria, France, Egypt, Argentina, Colombia, Spain, Peru, Algeria and Ecuador. Compared with 1975, exports from CHIRANA increased by almost 90 percent in 1980. During 1976-1980, exports to the West reached almost Kcs 370 million. [Prague SVOBODNE SLOVO in Czech 25 Mar 81 p 4]

CSO: 2402

TOXICOLOGY CENTER DIRECTOR SEES NEED FOR INCREASED CW RESEARCH

East Berlin NEUES DEUTSCHLAND in German 5 Mar 81 p 5

[Article by Prof Dr Karlheinz Lohs, director, Research Center for Chemical Toxicology, GDR Academy of Sciences: "That Science May Serve Peace--Leonid Brezhnev's Proposals Underscore Basic Concerns of Socialism--Research Must Have the Welfare of People as Its Goal"]

[Text] Probably never before in history has the problem of social responsibility of scientists been so important as in our time.

It would not be original for one to insist on continually illustrating the basic humanistic position of the scientist in the socialist society--our daily experience is proof enough that socialism alone makes possible a full unfolding of all creative powers of scientisits. In this development possibility for the scientist there is a positive provocation for every comrade to fully utilize all of his opportunities in the interest of social progress, to related his achievement-oriented thought to himself and thereby to his own work, and personally to see that he helps to determine the international level in his special field.

Here the question should be of a completely different dimension of personal responsibility. This concerns my function as member of the GDR government delegation at the UN disarmament talks in Geneva, as well as my assistance in the management group of the International Peace Research Institute in Stockholm (SIPRI) and as chairman of the International Disarmament Committee of the World Federation of Scientists. This deals with easily the most important task of our time, disarmament and safeguarding the peace. Never before in my professional career has the problem of my personal responsibility for the results of my research, for my own behavior and my support for our republic been clearer to me than in this function in the area of disarmament!

Partner in Talks over Means of Disarmament

Some will possibly ask themselves what, after all, an individual person can do--and a chemist and toxicologist at that among all the diplomats, politicians, military personnel, jurists and other social scientists. Well, it may be said that such discussions are practically concerned with the means and methods of the realization and control of disarmament measures, therefore also with the scientific and technical problems of the opportunities for their realization.

The GDR knows the danger of chemical warfare agents, because we have destroyed many thousands of tons of these poisons left on our territory by the fascists. But we know also that the United States and some of its NATO partners are presently stationing such weapons in increased concentration in our immediate neighbor, the FRG. In addition we know that the United States and other imperialist states are moving with full speed ahead in the murderous perfection of these weapons. As everybody knows, just in the last few months the United States and Great Britain have decided on additional armaments programs for chemical weapons.

When in international negotiations one is obliged to sit at the very same table with the representatives of the reaction and imperialism and to listen to their cool arguments about how they imagine the restoration of their lost positions of power, then often a great deal of self-control and a special form of awareness of responsibility as a citizen and scientist of a socialist country is needed in order to remain within the bounds of competence for negotiations. On such occasions one experiences a new variation of the class struggle of our day, which can be waged and won only because not just comrades X, Y and Z of the GDR delegation sit at the conference table in Geneva, London, Paris or Stockholm, but because standing behind them are 17 million workers of the first worker-and-peasant-state in German history, and because not just this or that weapons type and this or that treaty passage is discussed there, but indirectly and at the same time very clearly the existence of Leipzig-Gruenau, the preservation of the rebuilt Dresden, and the realization of the decisions of our party and government in a world of peace.

Lenin Course Again Impressively Confirmed

More than 500 billion dollars will be spent worldwide in 1981 for armaments--that is, every minute more than 1 million dollars will be supplied to arming. Even Karl Marx has told us that arming is the same as if throwing money into water. A consistent path denoting a policy of the preservation and defense of peace leads from Lenin's appeal for peace and the present-day demand of the socialist states for a European disarmament conference.

Socialism is the true embodiment of peace! Leonid Brezhnev offered the evidence in his universally observed speech at the 26th CPSU Congress. The proposals now on the table for far-reaching measures to build trust in Europe, in the Far East and in the Gulf region, the offer to negotiate with the United States over limitation and reduction in strategic armaments, the proposed moratorium on the stationing of additional nuclear weapons, or the initiative calling for a special meeting of the Security Council to improve the international situation are the logical expression of this responsible policy.

What, in view of the stockpiled weapons, is the meaning of the babbling of the imperialists about the so-called supplementary arming, which is nothing other than forced arming? The present world stock of nuclear weapons alone has the destruction potential of 1,350,000 Hiroshima-bombs. It is truly a perversion of thought and activity when the U.S. military personnel and their allies now want to add the neutron bomb to this nuclear weapons arsenal, and when they even give reasons designed to present such a means of destruction in the eyes of readers of the reactionary bourgeois press as the protective shield of Western civilization.

Disgust for the Cynicism of Imperialist Policy

When, in the light of such facts, one listens to the unctuous speechs of NATO politicians concerning their efforts on behalf of human rights and their constant spiral still tighter, then can each scientists but redouble his own efforts to deprive the imperialists of every opportunity of pushing the world into the inferno of war with nuclear weapons or with chemical and other means of mass annihilation.

Recently an internationally known American scientist expressed to me his disgust at the crocodile tears shed by many of his colleagues when the question concerns, for example, problems in the area of environmental protection, when they did not have a single word to waste when the U.S. Army furrowed the surface of Vietnam with 21 million bomb craters and 229 million grenade craters and destroyed almost half of the mangrove forests by spraying almost 50,000 cubic meters of plant poison. This progressive American colleague has written three scientific books of high quality on his assessment of the war damage in Vietnam--I know nothing of his receiving any of the many awards otherwise so liberally passed out in the United States when the matter concerns human rights and "fact finding" as they define it.

It is one of the greatest achievements of the socialist community of states that since 1945 they have made possible the preservation of peace in Europe. But let us not forget that during this time the imperialists in the rest of the world have started 126 wars!

In view of his own experience in the altercation with the forces of the reaction, one is motivated to new insights and conclusions in the perception of his personal responsibility; they cover the daily course of work in the institute and the perception of social tasks in party work as well as activity in popular organizations.

In regard to the scientist's own work, this means demonstrating in an exemplary manner to the institute staff and to subject colleagues a vigorous association of natural and social scientific thought, in order to thus contribute to a new quality in research work. It follows that it is important to orient the specific subject problems of one's own activity in the institute toward new complex solutions, thus, for example, to deal with environmental protection problems also as national defense problems.

Each Does His Part in the Common Struggle

It is a proven fact that peace is as secure as its defense, and this defense of peace is reflected daily at every work site and in every laboratory in meeting or exceeding the plans. Thereby the effective use of scientists' work time plays an important role.

The questions of responsibility shared by all leading scientists also concern the daily work with the new generation of scientists. Here it is more important than ever to personally impart experience and to educate politically in order to thus give young people an optimistic motivation for the experience realm of research, which fills the life of a scientist during his entire waking day and knows no eight hour day. I try to make that clear to the students in my function as a lecturer.

The 10th party congress will provide all GDR scientists with many new and responsible tasks worth of enthusiasm, which will challenge the work community in all research installations of the republic to do everthing within its power to further strengthen our republic and thereby make peace even more secure.

9746
CSO: 2302

HUNGARY

ENERGY CONSUMPTION IN FERROUS METALLURGY VIEWED

Technological Situation

Budapest KOHASZAT in Hungarian No 1, Jan 81 pp 1-7

[Article by university professor Dr Otto Farkas, PhD of technical sciences: "Technological and Energy Situation of the Ferrous Metallurgy"*]

[Excerpt] Presently the technological structure of our country's ferrous metallurgy's vertical still lags far behind world standards, primarily with respect to the phase of steel metallurgy. We have no oxygen-converter steel production at this time, and thus--as shown in Figure 3--we make all our raw iron into steel by the SM [Siemens-Martin] process. This represents 93.2 percent of our steel production.

Our SM-steel production's share will decrease significantly after the oxygen-converter and the combined steel production facilities now under construction are started up at the Danubian Iron Works, and at the Lenin Metallurgical Works; our electrolytic steel production will increase significantly, and oxygen-converter steel production will make a debut of significant proportions.

In 1990, the proportions of these technologies in our country's steel production will be 42.7 percent, 16.8 percent, and 40.5 percent respectively, corresponding to the above sequence. Thus, significant progress will take place in the structural proportions of the domestic steel production's technological verticals, and our lag [behind other countries] will significantly decrease; but--due primarily to SM-steel production which even then will have a relatively large share--our steel production's technological structure cannot be called modern in 1990 compared to the worldwide standards of that time, or even to the present worldwide standards.

The Energy Situation of Ferrous Metallurgy

The level of development of ferrous metallurgy's technological vertical--together with the quality of the available additives--naturally defines the energy demands of the process, and thus also determines the amount of energy used to produce 1 ton of steel. In 1979, the total amount of primary energy consumed to produce the world's 745.3 M tons of steel was 12.55 EJ [exaJoules; 10^{18} Joules] (16.84 GJ/ton [gigaJoules per ton; 10^9 Joules/ton]), which is 3.72 percent of the world's 337 EJ primary energy consumption. The way this energy consumption developed along the various technological paths--and thus also by countries--deserves particular attention not only because ferrous metallurgy is known to consume a lot of energy (65 to 70 percent of the energy consumption of a complete ferrous metallurgical plant), but also because the bulk of the energy sources used is a scarce fuel with increasing value, and one which is for the most part obtained from imports.

---

*Delivered as a presentation to the Scientific Session of the 1980 general meeting of the MTA's [Hungarian Academy of Sciences] Department of Technical Sciences, on 6 May [1980].

Taking into consideration certain publications which deal with energy consumption, Figure 4 [not reproduced] shows the development of specific energy consumption which at this time can be considered as average in worldwide terms, broken down to the various ferrous metallurgical technologies. These and the following energy consumption data assume full utilization of blast furnace exhaust gases, and take into consideration the energy quantity needed to operate the plant, but ignore the possibilities of deriving usefulness from the flue gases of the SM furnaces after these exit the regenerators, or from the converter gases and gases leaving the arc-furnaces. On the figure, the left side of the columns representing amounts of energy show energy actually consumed, while the right sides show the values of converting these to primary energy.

One sees that for 1 ton of steel, the energy consumption of technological verticals which also include a blast furnace, the production of raw iron [pig iron] requires by far the most energy (blast furnace-SM: 68.87 percent, or 68.61 percent; blast furnace-ox. converter: 84.04 percent, or 82.20 percent), and this share is significantly larger for the technological path of oxygen-converter steel production due to its higher demand for raw iron. As a consequence of this--in spite of the fact that the converter requires only a fraction (one-seventh, or one-fourth, respectively) of the specific energy consumption of an SM furnace--the energy consumption per ton of steel in the complete ferrous metallurgy vertical of oxygen-converter steel production is generally higher--though not by much--than the specific energy consumption of the blast furnace-SM technological path of producing steel. It must not be left out of consideration, however, that the oxygen-converter method of steel production uses significantly less scrap steel for producing the same amount of steel than does the SM steel production process, and by this it makes it possible to increase electrolytic steel production which has the lowest energy requirement, that is, it enables a given country to decrease its specific energy consumption in its overall steel production.

It is easy to see that electrolytic steel made from scrap steel requires the least amount of energy, which of course derives from the fact that ore preparation and pig iron production are omitted from this technological process. Thus, due to the rapid rise of energy prices it is becoming more and more necessary that in the interest of using as much scrap steel as possible the methods for preparing the poor quality steel scrap be improved, and that processes be developed for preparing steel scrap which now cannot yet be used economically.

The energy consumption of electrolytic steel production using sponge iron increases with the energy needed to produce the sponge iron, and for the pelletization which is a part of it. Looking at the values in terms of primary energy, we see that the specific energy consumption of this technological process is practically identical to the energy consumption of the blast furnace-SM, or the blast furnace-ox. converter technological processes.

Keeping in mind the amount of energy actually consumed, the sponge iron-electrolytic steel technological path is much more favorable. Within this, the energy requirement of producing sponge iron is smaller than that of making pig iron, but it must be taken into consideration that sponge iron production needs a much better grade of iron ore, and that the product appears not in a liquid, but in a solid state.

Improving the present poor degree of efficiency of electrical energy production (32 percent) would significantly decrease the energy requirement of the process. Further, if such a process would be available for melting down the sponge iron in which heat would not have to be converted into electrical energy, then back again to heat, the total energy consumption would be significantly less.

Steady increase of the amounts of electrical energy produced by nuclear power plants in the future will probably promote the growth of technological verticals which include electrolytic furnaces. Figure 5 shows a feasible schematic outline of a ferrous metallurgical combine operating with the use of nuclear energy. It can be seen that the process heat derived from the high temperature reactor serves not only to produce electrical energy, but a part of it can also be used directly for sponge iron production, and even for insuring the heat requirements of producing the reduction gases from hydrocarbons or from coal, needed for making pig iron.

However, in order for nuclear energy to occupy a significant place in ferrous metallurgy, it would be necessary to replace the present nuclear power plant systems--which use only about 0.75 percent of the fissionable materials in the ores--with so-called breeder-type reactors, the material utilization of which is expected to be between 50 and 70 percent. But the development of these reactors cannot at this time be considered completed from all viewpoints, and thus competitive breeder-type reactors cannot be built until 1990 to 1995, at the earliest. Consequently, the use of heat and electrical energy from nuclear reactors will not be significant until the year 2005, and it will become economical in ferrous metallurgy probably only in 2025.

Until the year 2005, hydrogen, solar energy, and geothermal energy will have little significance for ferrous metallurgy. Most of the energy savings expected until 2005 will come from better charge preparation, replacement of the obsolete equipment, higher levels of scrap utilization; and a smaller part of it from improving the processes. As a result of these, in 2005 energy consumption is expected to be 85 percent of the present level in the blast furnace-ox. converter technological vertical, 84 percent of the present level in the steel scrap-electrolytic steel production process, and 76 percent of the present level on the sponge iron-electrolytic steel technological path.

Our country is generally recognized as one with limited energy resources, thus the way the energy consumption of ferrous metallurgy's domestic phase will develop naturally calls for special attention. Our per capita confirmed fossil energy source inventory (3.3 TJ) [teraJoules; 10^{12} Joules] is only 54.1 percent of the world's per capita energy reserves (6.1 TJ). Within this, coal represents 2.8 TJ, petroleum 0.1 TJ, and natural gas 0.4 TJ in our per capita energy reserves. As a result of this, our barely mediocre energy supply position--not to mention the qualitative shortcomings (for example, the small amount of cokeable coal)--resulted in increasing our energy imports, which at the present time supplies 55 percent of our energy needs (within this, we import about 70 percent of our hydrocarbon needs, 20 percent of our solid-state energy sources, and 10 percent of our electrical energy needs). The imported part of our ferrous metallurgy's energy use is much higher than this.

Figure 6 shows the changes during the last decade in the amount of energy used directly in the national economy from its own sources and from imports, and of this the energy used by metallurgy, and by ferrous metallurgy. It can be seen that of the 970.45 PJ [pitaJoules; 10^{15} Joules] consumed in the national economy in 1978, metallurgy consumed 144 PJ, or 14.85 percent, and ferrous metallurgy 122.22 PJ, or 12.59 percent. The share of ferrous metallurgy in our country's energy consumption is large, in spite of the fact that it is continuously decreasing. The FRG's steel industry, for example, used 9.2 percent of the country's energy consumption in 1979, in spite of the fact that its per capita steel production is much higher than in this country. Averaging the figures for the time period under consideration, metallurgy used a considerable share, 15.76 percent of the country's total energy consumption; ferrous metallurgy used only a little less than this, 13.45 percent, which also shows that a very large portion (85.34 percent) of our metallurgical industry's energy consumption is used by ferrous metallurgy.

The above outlined technological situation of our ferrous metallurgy, and the very poor charging materials of our raw iron production also manifest themselves in the metallurgical vertical's high specific energy consumption. Figure 7 outlines, as a technological path, the energy consumed per ton of steel produced last year, and also that which is expected for 1990. It can be seen from this that our SM-steel production in the overall metallurgical vertical at this time consumes 19.88 GJ (in terms of primary energy, this is 23.48 GJ) of energy to produce 1 ton of steel. This is 27.6 percent more (25.76 percent more in terms of primary energy) than the 15.85 GJ (and 18.67 GJ figures, respectively) considered to be the worldwide average. The specific energy consumption of our electrolytic steel production is also very high, exceeding the worldwide average by 54 percent (and by 46.27 percent, respectively) (2.13 GJ per ton, and 6.31 GJ per ton, respectively), due first of all to the small size of our production units.

As a result of development activities currently under way in domestic ferrous metallurgy--including also the efforts aimed at improving the quality of the iron ores--according to the plans our present energy consumption values will decrease significantly, and even though they still will not reach the values currently characterizing the worldwide averages, they will approximate these.

Our SM-steel production shows that its share will significantly decrease by 1990, and its total specific energy consumption will be 11 percent (and 11.24 percent, respectively) less than the present. At the same time it can also be seen that this favorable change will be the result not of the smaller energy consumption of our SM furnaces, but of the decreasing energy demands of raw iron production. Actually, the average energy consumption of our SM furnaces will probably slightly increase due to the fact that the SM-steel plant at the Danubian Iron Works is being forced to convert to cold charges, and in spite of the fact that in the meanwhile the Csepel SM-steel works will be eliminated.

The per ton of steel energy consumption of the total vertical of our LD-steel production [Linz-Donawetz] will be practically the same as the total specific energy consumption of SM-steel production, as a result of the converter's energy requirement being much smaller, limited essentially only to oxygen consumption, and the increasing energy requirement due to its higher specific raw steel demand. At the same time, it must also be kept in mind that due to the significantly lower specific scrap steel consumption of the oxygen-converter steel process--as compared to the SM-steel process--it indirectly aids in the expansion of the capacity of electrolytic steel production which has the lowest energy demand, and thus promotes the decrease of the specific energy consumption of the total domestic steel production. But naturally, this also provides the opportunity to use more steel scrap also in the SM-furnaces.

Since our raw steel production will be consuming too much energy even then, the specific energy consumption of the entire metallurgical vertical of our LD-steel production even in 1990 will be 9.95 percent higher than the present worldwide average.

Decreasing the specific energy requirement of our electrolytic steel production will be connected basically to modernizing our arc-furnaces, increasing their number, and in part also to the introduction of ladle-metallurgy.

It becomes unambiguously evident from studying the development of specific energy consumption, that in the energy needs of ferrous metallurgical verticals which also include the production of raw iron, the amount of energy needed to produce the raw iron represents by far the largest portion. This circumstance obviously and unambiguously indicates that in the efforts aimed at decreasing the total energy consumed in steel production, the main task is to decrease the energy required for raw iron production.

According to conclusions drawn from Table 1, the total specific energy consumption of our raw iron production at the present time is 23.64 GJ (in terms of primary energy, 28.26 GJ), which is 26.42 percent higher than the worldwide average of 18.70 GJ. Examining the distribution of the energy items, it can be seen that coke represents by far the largest part--at this time, 70.98 percent--of the specific energy quantity introduced into the blast furnaces, and under our present conditions this means 685 kg [of coke] per ton of raw iron. The worldwide average of specific coke consumption fluctuates around 530 kg, but there are also some blast furnace works operating with a coke consumption of 400 kg per ton of raw iron. In addition to all this, we have to import two-thirds of our coke requirements for raw iron production, or almost 1 M tons a year; and even though most of this coke comes from the socialist countries, the present price of $180 per ton, or 5,120 Fts per ton, is a significant factor in our foreign trade expenditures.

Table 1. Specific Energy Consumption in the Domestic Production of Raw Iron

(1) Energiatételek	(2) Energiafelhasználás			
	(3) 1979-ben		(4) 1990-ben	
	(5) GJ/t	%	(5) GJ/t	%
(6) Koksz	19,22	70,98	16,06	68,74
(7) Földgáz	1,88	6,94	1,75	7,49
(8) Fűtőolaj	0,80	2,95	1,05	4,50
(9) Torokgáz	3,65	13,48	2,88	12,33
(10) Kamragáz	0,10	0,37	0,14	0,60
(11) Gőz	1,38	5,10	1,44	6,17
(12) Vill. energia	0,05	0,18	0,04	0,17
(13) Σ bevitt en.	27,08	100,00	23,36	100,00
(14) — torokgáz	−8,01	29,58	−6,58	28,16
(15) Felhaszn. en.	19,07	70,42	16,77	71,82
(16) + zsugorítm.	+4,57	16,88	+3,95	16,92
(17) Σ felhaszn. en.	23,64	87,30	20,72	88,74
(18) Σ primer en.	28,26	—	24,64	—

Key:

1.	Energy items	10.	Chamber gas
2.	Energy consumption	11.	Steam
3.	in 1979	12.	Electrical energy
4.	in 1990	13.	Total energy entered
5.	gigaJoules per ton	14.	- [minus-?] blast furnace gas
6.	Coke	15.	Energy consumed
7.	Natural gas	16.	+ agglomeration product
8.	Heating oil	17.	Total energy consumed
9.	Blast furnace gas	18.	Total primary energy

A smaller part of this excessive energy consumption can be attributed to the undisputable technological obsolescence of our blast furnaces--such as, for example, the insufficient temperature of the air used in them, almost complete lack of high throat pressures, the obsoleteness of some of our blast furnaces, lack of their instrumentation and regulation, the dust content of material charged to them, etc. However, the major part of excessive energy consumption is caused by the extremely poor charge material conditions. Our blast furnaces produce 440 kg of raw iron from smelting 1 ton of charge, while the Soviet Union produces 550 kg, Japan and the FRG 600 kg [from the same amount]. For each ton of raw iron, the domestic blast furnaces are forced to melt 850 kg of slag. This item is 400 to 450 kg in the Soviet Union, and 300 to 350 kg in Japan and in the FRG.

Therefore the efforts to process ores richer in iron are very important, as this will have to result partly in establishing ore-enrichment facilities, and partly in purchasing good quality ores.

It can also be seen from this table that the exhaust gas is an important factor of the energy flow in raw iron production. Therefore, its loss-free utilization, which to date has been solved only to the extent of 75 to 80 percent, must be solved at all costs.

Even though the specific energy consumption of our raw iron production is expected to significantly decrease by 1990, unfortunately it still will not reach the values corresponding to the present worldwide averages. In 10 years, specific coke consumption will still be as high as 572 kg, as per our current information.

Therefore, the charge composition planned now for 1990, which will represent 750 kg of slag per ton of raw iron, needs to be reviewed both from the technological and economic viewpoints.

As a result of decreasing energy consumption per ton of steel, as outlined above, the total energy consumption of our country's ferrous metallurgical vertical will remain practically unchanged--in spite of significant growth in our steel production. According to the data shown on Figure 8, in 1979 the ferrous metallurgical phase consumed 71.83 PJs of energy (86.26 PJs of primary energy), the largest part of which, of course, was needed by raw iron production, and a smaller part of it by electrolytic steel production. Total energy consumption expected for 1990 is almost exactly the same as the present value, but a favorable change will take place in the energy consumption of the steel production phase, and in its structural makeup--as a result of the introduction of LD-steel production. The energy demand of raw iron production will represent a larger part of the ferrous metallurgical vertical's total energy requirement than it does now, as a consequence of its increasing quantity, in spite of the decrease in specific energy consumption.

The domestic ferrous metallurgy's production will grow significantly, even though energy consumption will remain practically unchanged even 10 years from now. As Figure 9 informs us, our present steel production of 3.83 M tons includes 3.57 M tons of SM-steel, and 0.26 M tons of electrolytic steel.

Our total steel production of 4.69 M tons expected for 1990, including 2.0 M tons of SM-steel, 1.9 M tons of LD-steel, and 0.79 M tons of electrolytic steel, will mean an increase of 22.45 percent over the present level. This, of course, also involves the need for increasing our raw iron production and sinter production, which will correspond to 21.85 percent and 16.13 percent additional production, respectively.

Considering the growth of production and energy consumption together, the result is that without electrolytic steel the ferrous metallurgical phase's expected specific energy consumption will be 19.88 - 17.58 = 2.30 GJ per ton of steel, or 11.56 percent in 1990; with electrolytic steel included, these figures are 18.76 - 15.04 = 3.72 GJ per ton of steel, or 19.82 percent. In terms of primary energy, these items are: 23.49 - 20.94 = 2.55 GJ per ton of steel, or 10.86 percent, and with electrolytic steel 22.52 - 18.62 = 3.90 GJ per ton of steel, or 17.35 percent, respectively.

Considering the expected parallel processes of decreasing specific energy consumption and increasing production, it can be concluded that the change of technology which will take place as the processes of oxygen-converter steel production and the UHP [ultra-high pressure?] arc furnace-ladle metallurgical method become established, a process which is now in progress, and last but not least the efforts aimed at improving the charging and the technological circumstances of raw iron production, all support the proper direction of improving this country's ferrous metallurgy. As a result of the gradual implementation of the corresponding development plans, we will make significant progress in approaching the present international standards, even if we will not be able to erase the approximately one-and-a-half to two decade lag of our ferrous metallurgy in the next 10 years. In the meantime, we will increase our steel production in such a way that its share of the amount of energy used will significantly decrease in the national economy's energy consumption.

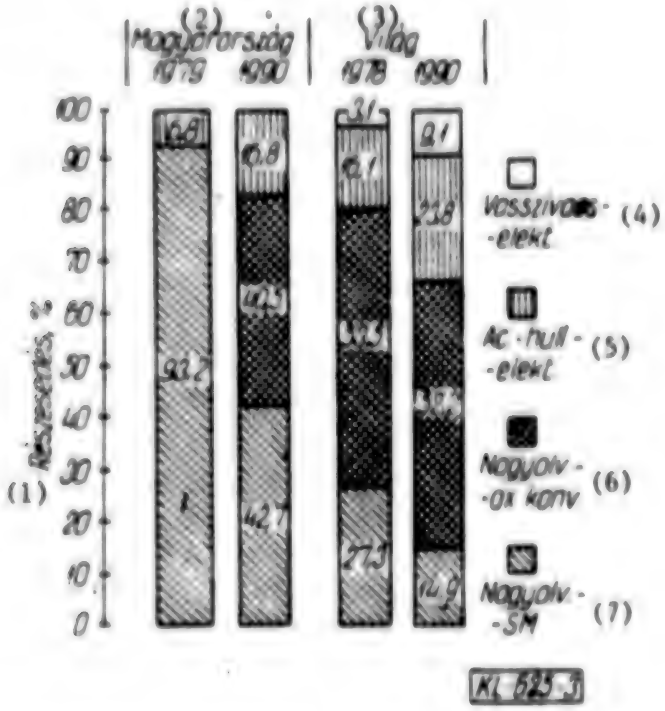


Figure 3. Percentage Distribution of the Ferrous Metallurgical Technologies in Steel Production

Key:

1. Distribution	5. Steel scrap-electrolytic
2. Hungary	6. Blast furnace-oxygen converter
3. World	7. Blast furnace-SM
4. Sponge iron-electrolytic	

[Figure 4 not reproduced]

Figure 4. Energy Consumption of Ferrous Metallurgical Technologies, GJ per ton of Steel

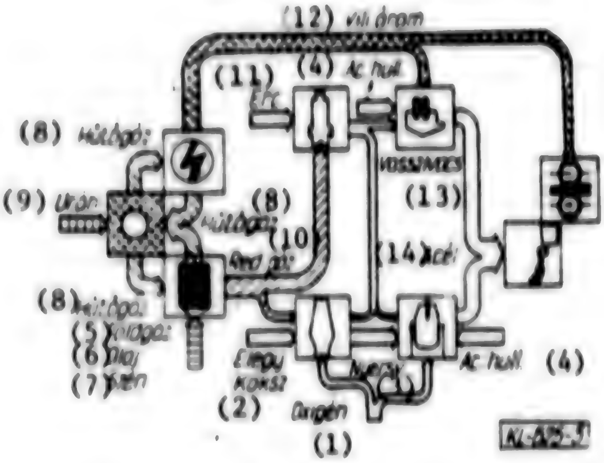


Figure 5. Use of Nuclear Energy in Ferrous Metallurgy

Key:

1.	Oxygen	8.	Cooling gases
2.	Charge coke	9.	Uranium
3.	Raw iron	10.	Reduction gas
4.	Steel scrap	11.	Ore
5.	Natural gas	12.	Electrical energy
6.	Oil	13.	Sponge iron
7.	Coal	14.	Steel

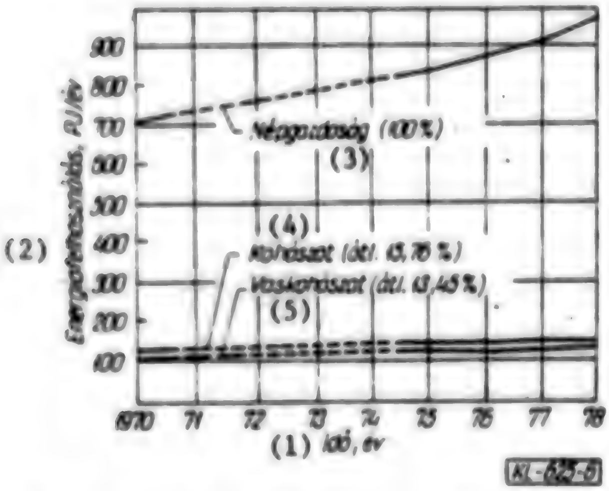


Figure 6. Changes in the Energy Consumption of the Hungarian National Economy, Metallurgy, and Ferrous Metallurgy, as a Function of Time

Key:

1.	Time, year	4.	Metallurgy (average: 15.76%)
2.	Energy consumption, PJ per year	5.	Ferrous metallurgy (average: 13.45%)
3.	National economy		

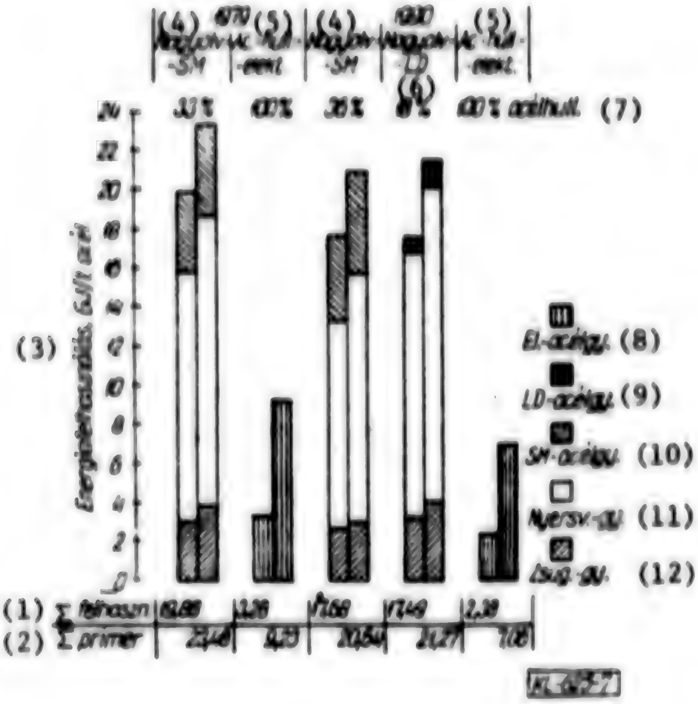


Figure 7. Energy Consumption by the Domestic Ferrous Metallurgical Technologies, GJ per ton of Steel

Key:

1. Consumed
2. Primary
3. Energy consumption, GJ per ton of steel
4. Blast furnace-SM
5. Steel scrap-electrolytic
6. Blast furnace-LD
7. Steel scrap
8. Electrolytic steel production
9. LD steel production
10. SM steel production
11. Raw iron production
12. Agglomerator

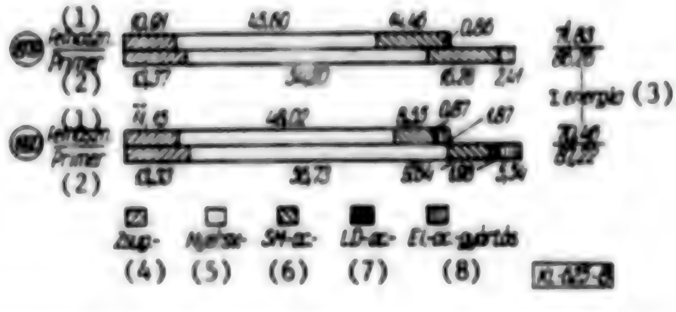


Figure 8. Energy Consumed in Domestic Ferrous Metallurgy, PJ per year

Key:

1. Consumed
2. Primary
3. Total energy
4. Agglomerator
5. Raw iron production
6. SM steel production
7. LD steel production
8. Electrolytic steel production

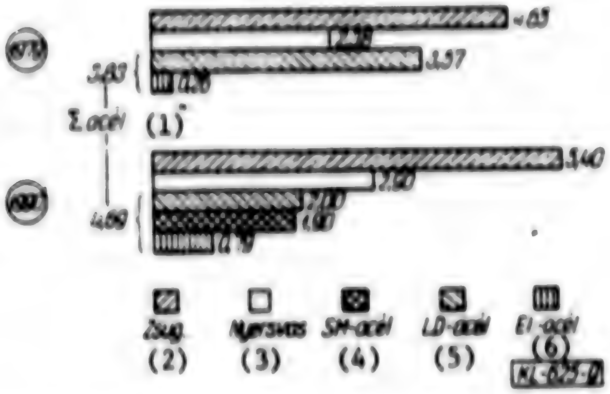


Figure 9. Domestic Metallurgical Production, M tons per year

Key:

1. Total steel	4. SM steel
2. Agglomerator	5. LD steel
3. Raw iron	6. Electrolytic steel

The Plant Viewpoint

Budapest KOHASZAT in Hungarian No 1, Jan 81 pp 8-10

[Article by Dr Gellert Repasi, PhD, dipl. metallurgical engineer, deputy general manager of the Danubian Iron Works: "Energy and Technological Situation of Ferrous Metallurgy From the Plant's Viewpoint"*]

> [Text] Results achieved all over the world in the area of decreasing the specific energy consumption of the ferrous metallurgical branch of industry. Domestic tasks. The development goals of Danubian Iron Works.

In recent years the international trade literature has been increasingly using the net amount of energy needed to produce 1 ton of steel or rolled products for measuring the specific energy consumption of the industry's ferrous metallurgical branch, and for comparing these. Even though these data are not completely accurate, partly because they are based on different correlations, and partly because the conversion factors between the participating types of energy differ, yet they are suitable for reading the main factors determining the industrial branch's energy management out of them. On Figure 1, for example, we see the data referring to the world's, and to the most important Western steel producing countries between 1950 and 1978. The amount of energy needed to produce 1 ton of raw steel fell from a value of 13.1 mWh per ton to less than 8 mWh per ton, while steel production increased more than 3.5-fold. Significant differences can be seen from one country to another. Progress is determined by concentrating the production of raw iron and steel in larger and larger production units. This is accompanied by, on the one hand, the better and better preparation of raw materials, and on the other hand, the intensification of high temperature metallurgical reactions. This manifests itself in the decreasing specific amounts of metallurgical slags, and in the rapid rise in the use of industrial oxygen.

---

*Presented as a comment at the Scientific Session of the 1980 general meeting of the MTA's Department of Technical Sciences, on 6 May 1980 (Editor).

The directions and speeds of progress of the various countries are nearly identical, but the differences between them with respect to their respective starting positions have hardly changed at all. The explanation for this is hidden in the very differences existing even today in the extent to which production is concentrated. While the overwhelming majority of Japan's steel production is produced in a few 8 to 10 m-ton steel mills, the USA and England, for example, are even today characterized by 2 to 3 m-ton steel mills.

In addition to production concentration, other definitive factors in steel production are utilization of steel scrap, and the share of pre-reduced pellets produced in increasing quantities to supplement these. We show this on Figure 2. While a large plant producing 8 m-tons per year uses 5,742 kWh per ton of steel produced according to this model, a 1 m-ton per year capacity plant, but one based on steel scrap uses only 2,400 kWh per ton, and a plant with 1 m-ton per year capacity based on direct reduction, uses 6,380 kWh per ton. At the same time, according to Figure 3, 56 percent of the energy requirement for steel production based on raw iron is coke, while 73 percent [of the energy need] of one based on scrap is electrical energy, and 50 percent of the one based on direct reduction is reducing gas.

Nowadays, about 16 m tons of charge are produced by direct reduction for the electrolytic furnaces. The expected rapid growth is explained by the energy management reasons: coke, that is, hard coal is not required for direct reduction, as the reducing gases produced from coals of low heating value can be used well for this purpose, as can the gases from coke production, the chamber gases. This development means a significant expansion of energy basis, and one which can be found everywhere, for the ferrous metallurgical industry.

A few important conclusions can be drawn from these data for developing our country's ferrous metallurgical industry. These are:

1. It is desirable to concentrate steel production (converters) based on raw iron production, to as large an extent as is possible. In addition to decreasing the number of blast furnaces, this also means radical changes in their charge mix conditions, and technological methods. More than 60 percent of the total energy consumed in the so-called integrated smelter works operating on this basis is spent on raw iron production. Since the forced oxygen converters represent the highest degree of efficiency in using the chemical and physical energies of raw iron, liquid raw iron should be permitted to be processed only in converters.

2. The share of steel production based on scrap should be increased, linking this with concentrating production in large units, in UHP furnaces. This would involve radical decreases not only in the number of the electric arc furnaces, but also their specific energy consumption. For long decades we considered the electric

arc furnace to be equipment producing fine quality steel, and we made their production capacity depend on the need for steel alloys. However, for a long time now they have been serving not this purpose, but the currently most economical remelting of steel scraps. "Refining" today is affected by ladle-metallurgical processes with smaller material and energy expenditures.

The need to expand the scrap base has led to extracting the Fe-contents of slags. Per ton of steel produced, the Fe obtainable from slag increases the scrap base by about 2 percent, and the good quality ore base by about 1 percent. In addition to gaining Fe and ore, the method's significance is increased by the opportunity to regain fire-resistant materials and nonferrous metals in the magnetic separation step, and to use the SM and LD slags for road construction.

In a temporary situation the SM furnaces can also be used for melting scrap. The DV's [Danubian Iron Works] medium-range steel production plan, for example, is also based on this. We can see in Table 1 that combining converter steel production based on raw iron, with SM-steel production adapted to scrap melting produces a result of no lesser significance than that there is no need for additional energy sources to increase steel production. The energy balance of a converter plant may also show such a surplus which would qualify it as an energy-generating unit. This situation occurs when the high temperature reactor gases generated are used for steam production, or, and this is even better, for heating material in metallurgical preheating equipment.

3. Raw steel-based converter steel production also makes it necessary to modify the ore base. This need also leads to examining the question: What may be the role of the direct reduction processes in our country's ferrous metallurgy? Looking at this both from the energy and metallurgical viewpoints, we arrive at the conclusion that this is the preferable path for expanding our steel production, mainly because this way the energy basis can be broader. That is, direct reduction of ores can be done not only by using natural gas, but also using chamber gases, and also reducing gases produced from coals with low heating value. At the same time we can also use these to substitute for furnace coke. Thus it also becomes possible to end the use of purchased foreign oil, or to limit it by the amount gained from coke gases. Thus, progress in this direction may end the dependence of developing the ferrous metallurgy on imported energy. This path also involves significant quality improvements, because charge materials obtained by direct reduction do not contain harmful impurity elements--primarily sulphur and phosphorus--the extraction of which by metallurgical process requires the use of large amounts of energy.

The theoretical energy requirement of integrated ferrous metallurgical plants is 3,400 kWh per ton of steel. Thus the energy utilization's degree of efficiency is between 45 and 55 percent. Some 17 to 20 percent of the balance shows thermal energy losses at high temperatures. To a large extent this loss is the consequence of the lack of continuity in the ferrous metallurgical processes. The preliminary and semifinished metallurgical products repeatedly cool off during the production process, and have to be repeatedly heated up again. The ferrous metallurgical industry is working on a huge development program to decrease this discontinuity. Its most important elements are: continuous steel production,

Table 1. Development of Steel Production's Energy Requirement

(1) Jellemző	(2) Kátrány-olaj	(3) Földgáz Gcal/t	(4) Összesen	(5) évi felhaszn. Tcal	(TJ)
Kemencére (6)	0,28	0,38	0,66	780	((3260)
Egyéb (7)	–	–	0,03	35	(146)
Összesen (4)	0,28	0,38	0,69	815	(3406)
Az oxigén (47 Nm^3/t) tüzelőanyag szükséglete (8)				119$^+$	(497)
Martinacél gyártás teljes energia szükséglete (9)				934	(3904)
60 0 et/év martinacél gyártásnál szilárd betét esetén: (10)					
Kemencére (6)	0,30	0,80	1,10	660	(2759)
Egyéb (7)	–	–	0,02	14	(58)
Összesen (4)	0,30	0,80	1,12	674	(2817)
Különbség a két gyártási eljárás között: (11)				260	(1087)
Konverteres acélgyártásnál (1,1 mt/év— (12)					
			Gcal/t	Tcal	(TJ)
Hulladék előmelegítés (10 Nm^3/t földgáz (13) (350 – 370 kg/t, 500 °C-os előm.)			0,08	83	(388)
Oxigen (53 Nm^3/t) tüzelőa. szükséglete (14)			0,11	126$^+$	(526)
Egyéb (7)			0,02	–	–
Összesen (4)			0,21	219	(914)
A konverter füstgáz hasznosításával elért tüzelőanyag megtakarítás (15)				330	(1379)
Összegzés (16)					
				Tcal	(TJ)
1978. évi martinacél gyártás során (17)				934	(3904)
600 et. martinacél + 1.100 et. konverteracél esetén (18)				893	(3721)
Megtakarítás az acélgyártás során (19)				41	(171)
Megtakarítás konv. füstgázhasznosítás során (20)				330	(1379)
Összes megtakarítás (21)				371	(1550)

$^+$8,9 kWó/Nm^3, 2460 kcal/kWó

Key:

1. Item
2. Tar oil
3. Natural gas, Gcal per ton [gigacalories; 10^9 cal]
4. Total
5. Annual consumption, Tcal and (TJ) [tera-calories; 10^{12} cal]
6. For the furnace
7. Miscellaneous
8. Fuel requirement for oxygen (47 Nm^3 per ton [Normal cubic meter])
9. Total energy requirement of Martin steel production
10. For producing 600,000 tons of Martin steel per year, with solid charge:
11. Difference between the two manufacturing processes:
12. For converter steel production (1.1 m tons per year)
13. Scrap preheating (10 Nm^3 of natural gas per ton) (350 to 370 kg per ton, 500°C preheating)
14. Fuel requirement for oxygen (53 Nm^3 per ton)
15. Fuel savings achieved by using the converter's stack gases
16. Summary
17. During the course of Martin steel production in 1978
18. For the case of 600,000 tons of Martin steel + 1,100,000 tons of converter steel
19. Savings in steel production
20. Savings through the use of converter stack gases
21. Total savings

continuous pouring, and recovering as much of the heat contained in the cast ingots as possible. Continuous pouring of the steel alone represents a saving of more than 320 kWh per ton, that is, more than 5 percent of the total energy consumption. To a decisive extent, the result comes from improved yields and from omitting the blooming roller mill [prestretching] step. Transferring the continuously cast ingots to the pusher furnaces while they are still warm provides the opportunity to save an additional 350 kWh per ton. Even today, the energy-frugal metallurgical technology is represented by the path of converting liquid raw iron to steel in high performance converters, pouring this steel as semifinished products in continuous casting plants, the classic blooming roller mill is eliminated, and the continuously poured ingot is transported while still hot (400 to 500°C) to the pusher furnaces. Thus, this plant uses over 10 percent less primary energy than the classic metallurgical technology. We are eyewitnesses of this process today.

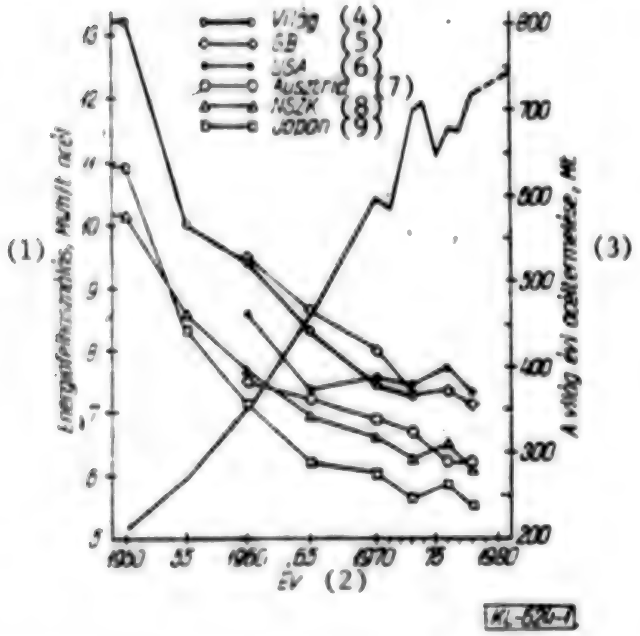
The so-called secondary metallurgical processes have been becoming more and more popular recently even in the large bulk-steel production plants. From the energy viewpoint their significance is in the fact that they use the primary furnaces only for melting and dephosphorization, therefore the specific performances of these may increase by even as much as 30 to 40 percent, and their specific energy consumption decreases by an even larger extent. Refinement, desulfurization, deoxidation, alloying, degasification of the steel is done in ladles. The extent of total energy savings depends on what heat losses have to be expected during these operations, and whether or not it is necessary to reheat the steel in arc furnaces, or subject it to remixing by induction during the processes. A ladle-metallurgical process without reheating is characterized by the fact that there is a difference of from 120 to 140°C between the tapping and pouring temperatures. There is significant research and development activity today to decrease the energy losses caused by this.

The development activity aimed at deriving use from waste energy is also in progress simultaneously with these metallurgical and technological changes. The most important stages of this are: using the waste heat energy generated during the process of dry coke quenching, representing 130 kWh per ton, to preheat coal, which represents an additional energy saving of nearly 600 kWh per ton; the use of so-called furnace gas backpressure turbines has great significance for blast furnaces, and represents the recovery of about 250 kWh of energy per ton. The high temperature gases containing 70 percent CO coming from the LD converters represent 175 kWh per ton savings if they are reintroduced into the metallurgical processes, and 120 kWh per ton if used to generate steam. But there are no solutions yet to recover the physical heat content of slags in raw iron and steel production.

Cooling water is a necessary part of operating the metallurgical equipment. The amount of heat carried away by it represents 14 to 16 percent of the energy used. In order to decrease these losses, cooling the equipment with an evaporator system is becoming more and more generally accepted practice, which converts the blast furnace, the SM-furnaces, and pusher furnaces into steam producing units also. The thermal energy recovered from cooling water also provides benefits beyond the fences of the metallurgical plants, because the amount of energy which can be recovered in the form of steam and hot water is larger than the needs of the metallurgical plants for these types of energy. Thus, full utilization can be achieved only by joining the community network, which on the other hand may also lead to significant benefits for the people's economy.

But in developing a long range energy program we must analyze not only the opportunities to effect savings, but we also have to consider the necessary additional expenses which will occur. The most important ones among these are the expenditures for environmental protection. If the legal requirements are to be observed, these will require expenditures in the excess of 100 kWh per ton, in addition to large expenses for investments. However, increasing the share of high quality and alloyed steels also requires extra expenses for energy. These extra expenses are caused by the addition of such--no longer avoidable--processes as, for example, vacuum technology, secondary metallurgy, electrolytic slag remelting, or rolling mills, casting, and forging facilities with higher dimensional accuracy, etc. In addition to all this, I would like to emphasize that the largest losses are still caused by the less than full utilization of the equipment, and its malfunctions, as well as downtime.

The above outlined technological and energy management solutions make up the main goals of energy-frugal technological development at the Danubian Iron Works. With their help we wish to further strengthen our position in the large energy management and technological competition among the integrated metallurgical works.



Key:

1. Energy consumption, MWh per ton of steel
2. Year
3. The world's annual steel production, M tons
4. World
5. Great Britain
6. USA
7. Austria
8. FRG
9. Japan

Figure 1. Development of Energy Utilization and Steel Production in Some Countries With More Significant Ferrous Metallurgy, Between 1950 and 1980

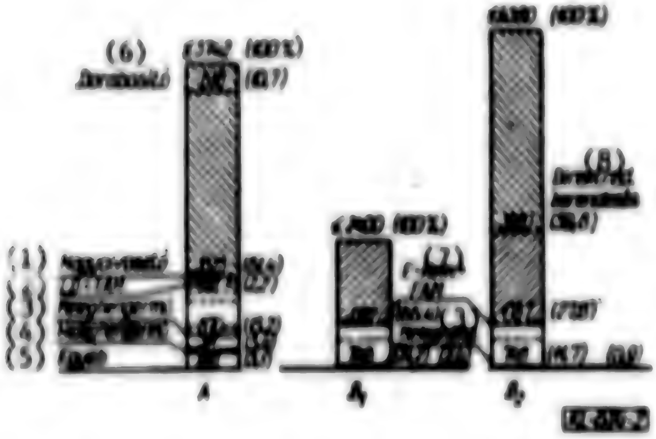


Figure 2. The Energy Consumption of Typical Metallurgical Facilities, kWh per ton of Steel. 1 kWh = 3,600 kJ = 860 kcal = 3,412 BTU; A = 8 m ton steel per year, on raw iron basis; B_1 = 1 m ton steel per year, on scrap basis; B_2 = 1 m ton steel per year, direct reduction basis

Key:

1.	Blast furnace	5.	Miscellaneous
2.	LD + FAM [expansion unknown]	6.	Agglomerator
3.	Hot roller works	7.	Electrolytic furnace + FAM
4.	Cold roller works	8.	Direct reduction equipment

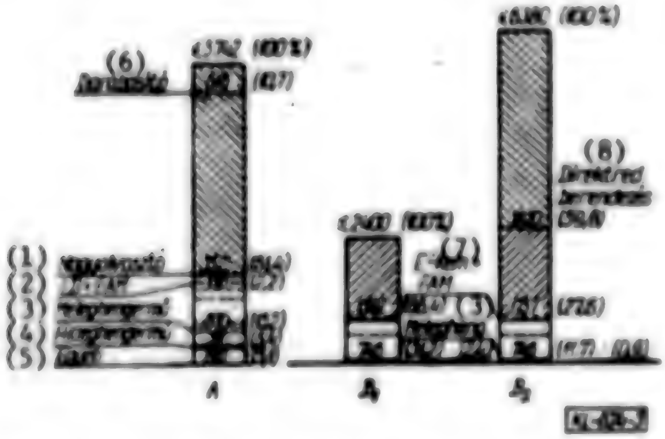


Figure 3. Comparison of the Energy Consumption of Typical Metallurgical Facilities

Key:

1.	Blast furnace	5.	Miscellaneous
2.	LD + FAM	6.	Agglomerator
3.	Hot roller works	7.	Electrolytic furnace + FAM
4.	Cold roller works	8.	Direct reduction equipment

8584
CSO: 2502

HUNGARY

RELATION OF MATERIALS TO TECHNICAL DEVELOPMENT OUTLINED

Budapest MAGYAR TUDOMANY in Hungarian No 2 Feb 81 pp 84-92

[Article by Mihaly Stefan, Correspondent Academician, Deputy Director of Csepel Iron and Metal works: "Our Economic Development and the Science of Materials"]

[Text] Beginning in the 1970's, many phenomena in the world economy have been observed indicating that we are on the threshold of a new era. The great economic development of many countries of the world in the 1950's and the 1960's, aside from certain temporary variations, was a continuous development that occurred on more or less unchanged bases. However, in the past several years various factors have appeared (price changes for energy and raw materials, the recognition of deterioration in the natural environment, etc.) which have forced basic changes in the entire area of management. Therefore, it is a matter of vital importance for every economy to recognize in time the direction of development possibilities, the forces which constrain a change of direction, and their effect on the individual economic branches, and in the possession of such information receive the changes in a prepared manner and take them into account in long-range plans.

The magnitude and nature of the changes that occur will be different in the individual areas of the economy. By examining the changes from the viewpoint of the structural materials, it will be recognized that because of the great time and cost demand of working out and introducing the basically new procedures the change will be directed not so much at the introduction of new, material-saving and energy-saving technologies but rather at the improvement primarily in the properties of materials (for example, high yield point or high tensile steel manufactured by micro-alloying and thermal treatment).

In the coming period an important outlook in the planning of industrial technologies will be its adaptation to human attributes, envrionmental protection and many other social factors (urbanization, the relationship of work and leisure, etc.). These requirements may become so strong as to force economic considerations into the background as already environmental protection and protection of human health (both in production and consumption) are definitive factors in our economic decisions.

The above-outlined lines of development require a constantly increasing volume of research and development activity, but this research and activity will be different in content and form, and has to be different from what we have been accustomed to until now.

Material Science and Material Technology

The economic effect of basic materials is defined by a combination of the properties of the materials and the investments made for their preparation and processing as well of the degree of exploitation achieved during application.

In the field of basic and structural materials, where the transition from basic material via semifinished products into components represents a constant process, the achieved scientific results, in the widest sense, are applied and used in the industrial branches for basic material manufacture, processing and consumption. By this means, a significant part of the national income is defined by the basic material question.

We can effectively make better use of the possibilities latent in the properties of materials or improve the properties of already known materials only by means of such systematic research in which the program extends all the way from the emergence of the idea to economic utilization; that is, the theory simultaneously embraces technology and application. By the means of such collective-type research, agrarian science can be cultivated in which the unified research goal is the solid material itself, with its development, its reaction capability, and its variability.

One of the basic pillars of material science is the solid state physics, the development rate of which is at present the highest among the sciences, and we can count on this rate to last at least until the year 2000. The other basic pillar is the solid state chemistry by virtue of ceramics and the new synthetic polymers. Moreover, various scientific disciplines play an important role, for example, metallurgy, metal science, chemical technology, crystallography, electronics, mathematics, organic chemistry, polymer chemistry, and not least of all those parts of the technical sciences which are closely linked to the utilization of materials. But despite the fact that it consists of many scientific branches as a whole or of their parts dealing with materials, material science must be regarded as a unified whole. The source for the basically new knowledge and theories is the solid state physics and chemistry, but in this research chain, in its interdisciplinary intertwining, we cannot omit a single link all the way up to material production and consumption.

For the very reason that the new outlook of interdependence in composition--structure--property links scientific investigation indivisibly with practical utilization, we use in coordinate conjunction the term material science and material technology. The combined use of this concept pair expresses the outlook better and is perhaps better linked to our tradition in the science of knowledge where pure science and pure practice were sharply distinguished.

Material science and material technology consists of metals and alloys, ceramics and glass, synthetics, monocrystals, and certain natural materials like wood, stone and sand. The categories are functions of time, and our knowledge is modified according to the changes in the scope of applying certain materials. Instead of the traditional grouping, it is more advisable (and today this is already the custom) to group the materials according to their application (for example, structural, electronic, biomedical, etc.).

On the basis of the above ideas we can state that material science and material technology deals with the composition of materials, their structure and processing, as well as with the discovery and application of knowledge regarding their properties and consumption. It follows from this general definition that the subject areas of material science and material technology and their border areas with other subjects not specifically their own do not differ sharply form one another (as in the traditional division of subjects), and as a function of time the component factors change and are modified.

The sciences dealing with materials developed over a long period of time according to strict (rigid) subject divisions. Physics, chemistry, metallurgy, ceramics similarly were divided in corresponding areas of industry: Metal, glass, ceramics, chemical industry and so forth. This devision is no longer adequate; we need complex approaches for the realization of our goals. Material science--material technology is the natural meeting place for natural scientists and technical specialists. From basic research to applied research, to development, to the working out of procedures, and to practical introduction they are linked together by the chain of results in the structure--properties--function of materials.

For the creativity of a unified and therefore viable material science and material technology, it is indispensable that we conduct not only program-type research and rely occasionally on the foundations of basic research but also that we have a relatively broad basic research base. Without basic research serving knowledge that is not always in the possession of concrete goals, innovative technological possibilities would be slowed down. This slowing down would be great in the dynamically developing industrial branches (for example, electronics). Basic research is not only the key to continuing improvement in certain areas but is also frequently the source of dramatic innovations (for example, applied science or technology designed to improve incandescent lamps or fluorescent sources of light could never have developed the lasar).

In the accompanying table we show some results in material science and material technology arranged in three columns (basic research subject, material or method, and application examples. With this we wish to review the mutual interrelationships of the three categories, and the way they are built one on the other. Basic research can be in a very close relationship with technology as in the early phase of transistor research, but these can also be in loose relationship as in the case of surface research where a great deal of knowledge had to be accumulated before it became possible to handle the practical question of catalyzation or surface modification. There are cases where basic applied research build on each other in tiers, like cobalt in the case of rare earth metal magnets.

In material research, a part of the work reacts on the well-outlined demands of the new constructs. Often, however, material development is the key to completely new constructs (for example, soft magnetic materials--computer memories, integrated circuits, microprocessors, and machine tool controls). Whether material development reacts or is creative, the result always arrives to the consumers via the planning or application of technicians. Therefore, the relationships between the developers and the planners of materials are cardinal points of material science. Given the very strong and mutual dependence, only such systematic cooperation can be effective which recognizes and takes into account the effect of change at any point of the system on the system as a whole.

Our products are put together from the system of materials. Changes in any part of the system can have a great effect, and at times it makes complete replanning necessary (for example, the glass fibers which absorb little light and may replace copper cables in communications on a long term and broad scale).

A system technology outlook is necessary in the field of material science and material technology also in order that we realize an optimum combination between the development of material and final consumption. This means that we must examine material properties--processing methods--energy consumption--consumption conditions--environmental protection requirements--economic factors in light of the interrelationships of the research-development process.

Because of the manifold nature of the tasks, we cannot give a uniform formula for the most effective organizational framework of the cultivation of material science--material technology. In general, it is necessary to systematically organize the common work of specialized scientific branches. On the basis of experience acquired in industrially developed countries, it can be said that outstanding results have been achieved in research institutes and laboratories where an industrial-economic attitude or outlook has prevailed, that is, they recognized the vital role of materials in technical and economic development.

TABLE

Basic Research	Material or Process	Examples of Application
The effect of pollutants on conduction properties; crystal growth studies; dislocation theory	zone purification; regulated alloy building; monocrystal growth	transistors, tunnel diodes; integrated circuits
Compound semiconductors; optical properties (luminescence, electroluminescence)	gallium-arsenide, gallium phosphide	light diodes; semiconductor lasers; high velocity means
Phase equilibrium studies between extremely high pressure and temperature relations	Artificial diamonds; super hard polycrystaline materials (e.g., bornon nitride)	cutting machine tools; tool adapters; grinding materials
Sintering theory; thermal treatment basic studies	powder metallurgy; high-tensile alloys; high-density transparent ceramics	precision parts; ceramic turbine blades; illuminating glassware
Magnetic alloys: the relationship of magnetic properties with composition and microstructure	grain-oriented silicium steel; iron-nickel alloys; cobalt-rare earth metal alloys	transformer cores; amplifiers; electronic magnetic materials; high performance machinery
Superconduction; electric, magnetic, thermodynamic properties of metals at extremely low temperatures	new superconductors; superconduction switches; thin, superconduction films	generators operating with superconductors; energy delivery and storage

Basic Research	Material or Process	Examples of Application
Surface chemistry; oxidation-reduction reactions; electrochemical, electrode kinetics	catalyzation; surface modification	accumulators; hydrogen-oxygen fuel cells; corrosion prevention
Study of physical-chemical processes at high temperatures	oxygen steel production; fire-resistant materials; protective coatings	converter steel production; cauldron metallurgy; long-life furnace lining; anti-corrosive components
Studies in fluid-solid phase transformations: crystallization	guided crystallization; continuous casting; metal filament drawing	new iron and metal metallurgy plants (DFMC copper wire and metal strip manufacture; horizontal continuous casting of steels)
Thermodynamics of phase diagrams and chemical processes; the solidifying effect of second phase particles	micro-alloyed, high-tensile steels; dispersion alloys (internally oxydized Ag, Al, CU, N-base alloys)	structural steels, aviation technology materials, Al-, Cu-conductors; high tensile alloys
Superplasticity	Super-plastic alloys (e.g., Al-Ca-Zn) and methods	Complex, high precision components
Glass condition	Glass-metal alloys and composites, extremely rapid cooling methods	Anisotropic magnets, tool adapters, building industry structures

The materials now currently utilized exceed by far the most common and easily accessible elements in the earth. Development is expanding the scope of raw materials with more and more rare elements and new kinds of element links and binding combinations. At the same time, a change in the world value system of raw materials can be observed. Among the elements of the periodic system, the importance of lithium has increased as compared to the other alkali metals. Within the group of rare earth metals which were formerly regarded as uniform and unimportant (Mischmetall) characteristic properties of many elements have been recognized and are being used extensively. An example of this is ytrrium, or samarium the most important component element of the new hard magnets with great coercive force. Today gallium is more important than germanium. Vanadium is being used in wider and wider scope as a structural material in nulceartechnology, and the bio'lium compounds (special crystals of niobates, Nb_3Ga, Nb_3Sn--superconductors, etc.) as an alloy for improving the properties of steel. This change in the value order has made a series of scattered and rare elements important, the occurrence of which--and primarily in the extraction from red mud that comes from alumina production--may afford recompense in the near future for the shortage in Hungary of classic raw materials.

In the following I shall review a number of noteworthy examples by mentioning related domestic results and economic possibilities for the exploitation of which it will be advisable to take into account our raw material and energy endowments and our possibilities stemming from the industrial development.

New Steel With Improved Properties

In Hungary we use more than twice as much steel (and aluminum) per unit of added value as in the industrially more developed countries (for example, Austria and France). Therefore, it is an imperative requirement of material and energy savings that in the material and application field the effort at more efficient utilization, that is, greater added value per mass unit, should become a universally prevailing trend. Technological progress in our present and future will be guided thereby; only the improvement of structural materials and particularly of properties of steel used in the greatest mass, developing new steel types and the maximum exploitation of properties may result in a significant decline in the weight of the products and at the same time in making them more modern and more economic from the viewpoint of production and consumption.

The modernization of the product structure of our iron metallurgy and our machine industry and the growth in the economic efficiency can be basically served by those advantageous qualities which the wide-scale introduction of manufacture and consumption of new steel types that are micro-alloyed (have an increased yield point, are high tensile, are more corrosion resistant, and are readily weldable and workable). Their improved properties will make up severalfold for the additional expenditures that make them more expensive than ordinary carbon steels. The great advantage of some modern, new steel types is that they do not require thermal treatment (energy savings) because its outstanding properties are assured by being allowed in a V, Nb, Ti, Zr, CEMM small concentration (0.01-0.15 percent) and by its so-called innovative or regulated thermal formation. The theoretical basis, in outline, of its manufacture is the following. As is well known, the strength of steels is defined by three strength-increasing mechanisms: 1. grain refining; 2. atoms in instertitial and substitutional solid solution (N, C, B, Mn, Mo, Ni, Si, etc.); 3. dispersion particles (second phase).

Grain size regulation in the process of thermal transformation can be advantageously achieved with V (and Nb) micro-alloying. The size of the grains and their distribution (that, the distance between them and the breadth of the range (0.1 mm on the average) depends on the temperature of the transformation. Alloying in V (and Nb) small concentration is promoted by an increase in strength and toughness, while the Zr, Ti and CEMM modify the nonmetallic inclusions.

In the development of steels the effort is directed at planning ahead the properties that are desired (yield point, rigid transitional temperature), the safety composition, the structure (grain size) and the major technical parameters. From the announcements on the new, improved steels it can be stated:

--by means of micro-alloying based on material planning or by regulated thermal transformation, a significant development of properties can be achieved with slight expenditures;

--the utilization of presently available steel production capacities will thereby be more efficient and economic;

--in structures where the yield point is the decisive measuring criterion, it will make possible a minimum weight reduction of 25 percent, but in certain structures a 40 percent reduction can also be achieved;

--in the consumer industry it will offer the possibility for many material and energy saving technologies and new construction solutions (for example, welded structures instead of castings; the omission of thermal treatment in the manufacture of heavy machinery and agricultural machinery; more intensive processing, greater output and life span, and so forth).

In recent years, domestic iron metallurgy has achieved noteworthy results in the development of modern steels. At the Damube Iron Works, for example, they have solved the problem of manufacturing the DX 60 increased yield point (450 N/mm^2) of spiral-welded steel pipes, and increased yield point, readily weldable thick sheets. However, the ratio of steels that is used by the domestic industry and may be judged as modern is still only about 27 percent. The major role in this lag is played by the undemanding attitude of consumers and by partly objective and partly subjective factors.

By better exploitation of domestic technical and scientific results and research-development capacities--considering the DV and LKM converter steel works developments, already existing or to be realized in the near future, and the introduction of modern steel production technologies (e.g., cauldron metallurgy)--we can set as a realistic goal a 10 to 12 percent reduction in domestic steel consumption, or an icnrease of 350 to 400 kt's in the volume of manufactured products without the consumption of additional steel. To attain this goal, prospects are particulayly bright for the utilization in improved steel of a part of the vanadium that can be extracted by the complex processing of the red mud that has accumulated up to now (about 10 mt) in the production of alumina and in future accumulations.

Domestic iron metallurgy already has available production technologies with which it can satisfy the higher level demands that are emerging. But we must also see that a faster rate and broader scale of modern steel production is still hindered, in addition to unsolved technical problems, by the reciprocal unfavorable effects of many factors. These include price problems, patent and information questions, and not least of all the technical-economic predisposition of the consumers.

Glass Metals

Glass metals constitute a solid state group of with unusual and in some cases wholly outstanding physical and mechanical properties and corrosion resistance. The silicate glasses with which we are familiar in everyday life and several polymers are well known for their characterisitc of cooling from a fluid condition without crystallization. It was impossible to fully realize this condition until most recently with molten states. In 1960 we succeeded in bringing about those special conditions which assure that a long-term order characteristic of the crystal condition will not form from recurring unit cells. Such solid-state metals and alloys are called glass metals.

The great practical importance of glass metals is due, in addition to their unique properties, to the economy of the technological process necessary for their microstructures (the metal bind among the atoms and the isotrophy inherited from the fluid condition). The determining factor in the manufacturing technology of glass metals is the critical cooling off speed following the melting of the alloy, which is greater in various orders of magnitude than in the case of silicate glasses. The advantages of technological procedures based on the rapid cooling of the molten state are material and energy savings, environmental portection; also, it does not require intensive work, and various technological operations become superfluous (casting, hot and cold shaping, and heat treatment).

After the cooling of process, the material is relatively plastic, and can be worked out. The density of glass metals scarcely deviates (1 and 2 percent) from materials of the same composition and crystal structure, but as a result of their structural variation their mechanical properties exceed their properties severalfold. (For example, the glass alloy $Fe_{78}Mo_2B_{20}$ has a maximum tensile strength of 2600N/mm^2, and the $Fe_{80}B_{20}$ alloy of 3200N/mm^2.) The corrosion resistance of glass metals is outstanding because they do not have surface tension differences deriving from the orientation of grain borders, precipitation, and crystal grains. As a consequence of their structural homogeneity, we succeeded in producing extremely soft magnetic glass alloys (for example, $Fe_{40}Ni_{40}P_{14}B_6$). Glass alloys that have been developed thus far embrace the full scale of magnetic behavior. Their one disadvantage is that the glass condition can only be maintained only in a relative narrow temperature span. At climatic temperatures they may be regarded as relatively stable. In materials known to us thus far, crystalization occurs in the range of 250-650°C depending on the composition of the materials.

Glass metals that have outstanding physical and mechanical properties and can be produced economically are very attractive to the industry. We are only beginning to exploit their application possibilities. Many technical and scientific problems need to be solved for their wide-scale application. On the basis of their great strength and durability they are suitable as fiber strengthening in tires, V-belts, and high pressure pipes; because of their hardness and wearability they are suitable for making cutting tools with a long life span. Because of their electrical resistance value, they can be used in resistance elements and thermometers. They are extraordinarily corrosive resistant, not only to salt water but also the new biomaterials and to radiation. On the basis of their magnetic properties as well the scope of their consumption possibilities are broad (for the most varied type of transformers, magnetic amplifiers, tape recorder heads, magnetic memories, magnetostrictive decelerators, and so forth).

A mode of consumption with great advantages will also be found when a glass-state, a so-called metal enamel layer on the surface of polycrystal metal containing glass-forming elements can be produced. Thereby it will be possible to greatly increase the hardness, durability and corrosion resistance, and to increase the life span by 200 to 500 percent on the active surface parts of finished structural elements.

The Institute for Solid State Physics of the Central Physics Research Institute joined early in the work being conducted in the field of glass metals, planning and implementing the research tasks in conjunction with the Csepel Works. In developing rapid cooling procedures, a task for the near future is to establish an experimental pilot plant where a cable or strip can be produced in a one step process from liquid alloy. Among the other methods for production of glass metals (powder metallurgy, condensation from steam phase, electrochemical processes) the electrolysis method may be regarded as solved and applicable on an industrial scale in continuous and intermittent operations (the Metal Science and Technological Research Institute of The Csepel Works). Practical uses are being designed by the Budapest Radio Technology Factory (soft magnetic glass alloys) or by the cooperation of the Bacs Megye Construction Industry Enterprise and the Csepel Works.

In addition to the many new application possibilities (equipment, communications and electronic technology), the economic importance of the material is also indicated by the fact that by taking the mechanical properties of 1 ton as the base, it can replace 4 to 6 tons of traditional steel, and in its production and to produce the same volume an energy savings of 80 percent can be attained.

Ceramics

The traditional area of the ceramics industry and powder metallurgy is the reaction within the solid state or between the solid phases--the contracting and the sintering process. With the discovery of the interrelationship between the compositional structure and property, the technological parameters can be defined on a theoretical basis. Compared to classical thermal treatment (high temperatures and great pressure) hot-pressure technology has changed significantly by virtue of using the most different kinds of additive materials (micro-alloys or mineralizers). To attain the appropriate density, atmospheric pressure is sufficient in most cases (for example to produce silicon carbide. By choosing the appropriate micro-alloy, the final product can be made either a nonconductor or conductor.

The interstitial compounds which contain small N, C, B atoms play a leading role in the field of new ceramics. One of the most important representatives is silicon nitride which is close to Si_3N_4 in composition, a structural material of great strength and resistance to thermal shocks. The information acquired in the studying this material has been extended to the entire family of materials. Even at high temperatures (1600°C) the new structural materials resist oxygen. They can also come in contact with molten or caustic agents (for example, metal cerium can be melted in a cerium sulphide vessel), and they also meet special durability requirements (for example, for tool materials). A significant savings in weight and an increase in life span can also be attained with their application. By stamping and casting into form, by injection casting, and by pressing the most varied shapes for spare parts can be made of LaB_6, HfC, ZrN, TiB_2, TaC, BN, B_4C materials.

In many areas they can be used more economically than the traditional metal structural materials. The MTA [Hungarian Academy of Science] Inorganic Chemistry Research Center is conducting research in cooperation with the Soviet Union to control pyrolysis of organic silazanes (Si--N--C system).

Composites--Associated Materials

Composites are produced from two or more components with different properties into a single unified material structure with exceptional characteristics. One of the oldest representatives of composites is ferro-concrete. In production, they imbed a high-tensile, laminated, fibrous, or sometimes granular material, a "reinforcer" into an amorphous or microcrystal matrix--and thus a particularly strong, crack resistant new product is formed. The matrix may be glass or cement, but more recently metal as well, for example, Al or Si [has been used]. The reinforcing material may be glass, ceramic, metal, a metal element, or a metal compound.

Worthy of note is a material that promises much in the near future, the polycrystal Si-SiC alloy for which an inexhaustible raw material source is available. It is super-light and much harder than ceramic. It is more heat and corrosion resistant than the well-known steels and alloys. It can be precisely cast, and can be worked into its final form with great precision and little loss with synthetic diamond tools. Production is based on the direct reaction of molten silicon and carbon filament, which is regulated by micro-alloying. Its particular advantage is that even at high temperatures there is no reaction between the strengthening fiber (SiC) and the matrix (metal Si) as is the case with the other associated materials. As far as I am aware, there has been no report as yet on domestic research results.

Vitro-ceramics belong among the associated materials; here with the regulation of the composition and the cooling porcess, a small crystaline texture is formed in the glass matrix. Significant results have been achieved in this area domestically in wake of the joint work by the Experimental Institute of the Glass Industria; Works and SZIKTI [Central Research and Planning Institute of the Silicate Industry].

The Future of Material Science and Material Technology

In the future, too, material science and material technology will afford us primarily new materials, new methods, and new material systems, as well as lend to the improvement of existing technologies and material properties. The major goal will remain unchanged to develop materials which meet special requirements and/or create new application possibilities. Its role is to recognize the areas that require basic research and help in the development of research. On a broad scale material science is capable of improving the compositional structure of many existing products or their output. It creates new industrial branches (for example, solid state electronic industry).

Like any science, material science and material technology changes rapidly over time. The extension of the interdisciplinary principle will continue to accelerate in the coming period. The most science-intensive programs will add to this spin-off. The broadening of the interdisiplinary principle will also be increased by the fact that the finished product industry would like to achieve constantly greater results and constantly lower production prices for its products. Society demands materials are processed with dangers and environmental pollution by industry. The popular demand will increasingly grow in respect to the quality and reliability of the product. Because of the increasingly more expensive cost of individual service, the driving force will be greater to work out new technologies and more reliable new compositional structures. From the known social and economic demands today we can conclude that attention will be increasingly turned toward material development, the results of material science will be maximized to make human life richer and more beautiful.

6691
CSO: 2502

HUNGARY

CONTROL PROBLEMS OF THE MACHINE INDUSTRY

Budapest SZAMITASTECHNIKA in Hungarian Dec 80 p3

[Article by Zsuzsa Szentgyorgyi: "Machine Industry Control Problems"]

[Text] A four day international symposium sponsored by the International Automatics Federation (IFAC) and the IFIP [expansion unknown] was held at the end of October in Budapest, at the headquarters of the Hungarian Academy of Sciences, with the title Manufacont 80 (Control Problems and Devices of Manufacturing Technology). The symposium had more than 150 participants, of whom 57 were foreigners. Modern and progressive control technology tools, methods and procedures used in machine manufacture technology were discussed in a total of 46 delegate presentations and five plenary presentations, in four sections.

Technical Development

The entire symposium involved the use in the machine industry, in machine manufacture technology, of the possibilities deriving from the technical development of hardware components and the reduction in the specific price of them. The first section discussed how the significant reduction in size of computer technology devices, their greater reliability and relatively cheap acquisition price were opening new vistas for control devices and systems which are being used or could be used in the machine industry. Emphasis was given to the use of computer technology in design (Computer Aided Design, CAD) and technology (Computer Aided Manufacturing, CAM) and to the development of systems which integrate these two closely related activities. This area of computer technology occupies a central place in Hungary also. Gyula Hermann and Laszlo Horvath reported on this in their presentation titled "A Hierarchically Controlled Experimental Manufacturing Unit." Domestic developments in software were discussed in reports by Peter Hoffman and Matyas Horvath titled "Development of a New Machine Tool Programming Language" and by Ivan Bach, Erno Farkas and Laszlo Megyeri titled "A Process Control Operational System With Interrupt Guided Scheduling." Great attention in the section was evoked by a presentation by Pal Verebely titled "A Modular Microprocessor System." He reported primarily on the GD-80 family which can be used in CAD systems. Three Czechoslovak papers reported on CAD/CAM developments and applications there. In a paper titled "Control of a Flexible Manufacturing System in the Czechoslovak Machine Industry" K. Elias pointed out that only the full automation of the given technological process can mean integrated control of manufacturing processes. J. Soucek and J. Bekes spoke of a plan for an experimental CAD/CAM system being prepared in the machine industry department of Bratislava University. The paper by J. Muransky and M. Tkacik reported on an indegrated CAD/CAM system which can be used with stamping machines.

system to control an automatic painting robot being prepared for the Ikarausz factory. Japanese authors reported on a navigation procedure for a robot vehicle system using a minicomputer (T. Nakamura and I. Fukni in "Robot Vehicle Navigation with Form Recognition"). Italian researchers, using a simple sensing and control system, solved the problem of guiding and positioning non-symmetrical mechanical parts (A. Romiti, G. Belforte, N. d'Alfio and F. Quagliotti in "The Positioning of Randomly Fed Three Dimensional Parts").

Finally, the fourth section dealt with theoretical questions of controls and problems of measurement, supervision, identification and positioning. In this section the work of Japanese authors must be called the most interesting, namely a report on a laser procedure which can be used in LSI manufacture (I. Oshima and N. Mohri in "Positioning a Micro-Figure With a Laser"). Translation deviations are sensed with a bolographic process, with the generation of an optical autocorrelation function, while rotational deviations in the plane of the base are sensed by using a Fraunhoffer diffraction picture.

Magnetic Bubble Stores

Perhaps the most exciting event of the symposium, an event pointing the way in international competition, was a plenary presentation which was not so much scientific as an advertisement for the products of a given firm--a work by the Japanese S. Inaba titled "The Automation of a Machine Factory Using Computerized Numerically Controlled Machine Tools Working With Large Capacity Magnetic Stores and Robots." The author presented very vividly the "dramatic" changes which have taken place in the control of machine tools and machine industry equipment thanks to the integration of semiconductor components. In 1967 the diodes, transistors and passive elements on about 300 printed circuit boards performed essentially the same functions now carried out by single LSI's (microprocessor, ROM, RAM, etc.). By comparing various user LSI's it can be seen, for example, that at a low level of integration an interpolator required 261 printed circuits and a position control required 305 while at the present level of development these functions are carried out by one LSI each. The sensation of the presentation, however, was the solution of memory operations "without tape." The FANUC firm uses magnetic bubble stores on the CNC. The advantages of these, Inaba pointed out, are their resistance to the environment, their information density and the fact that--in contrast to semiconductor stores--the contents are not volatile, so no separate power source is needed. The CNC can store a number of different programs for a few days or even months. The machine tool is integrated with a robot; the CNC guides both simultaneously according to the program. The machine tool works on the parts on a continuous basis while control sees to compensation for tool wear and adjustment of the work process.

In conclusion the author noted that while use of NC machines was a signficant achievement in machine industry automation there has not yet been an adequate solution to automation of ancillary processes--such as loading and removing parts to be processed, exchanging tools, removing turnings, etc. And yet these operations are especially important in the manufacture of small series products. For this reason the conception of the FANUC firm seems to represent significant progress.

8984
CSO: 2502/58

The CAD/CAM systems have special significance in countries where the ratio of small series and one-time products is high in the machine industry (as in our homeland also). With their aid one can design and begin manufacture of new products quickly and flexibly and with short down times. In the second place small series manufacture can be made more economical when linked with production control.

Exploitation of Devices

The second section was closely linked to the first; it discussed ways and means for optimal exploitation--technologically and economically alike--of the very valuable tools of production. In a presentation titled "A New Supervisory Principle for Adaptive Controlled Machine Tools" Janos Somlo pointed out that the machining process can be linked to production control. Thus in the future when the price of hardware components makes it economically acceptable to make broad use of adaptive controls it will be possible to develop theoretically new, flexible production systems. A presentation by Marton Girnt and Erzsebet Szelke titled "Adaptive Control in Production Scheduling" was linked to this. The authors reported that in their adaptive scheduling method they exploited changing possibilities in the machining time of metal cutting operations.

It was interesting that both Hungarian and Italian speakers reported on similar equipment, already realized or to be realized, for optimizing adaptive machine tool control (Ferenc Marossy and Pal Szasz in "An Experimental System for Optimizing Adaptive Controlled Machine Tools" and R. Bedini, F. Mancuso and P. C. Pinotti in "The Development of Adaptive Limiting Control for a CNC"). It was noted in the presentations that adaptive controls in metal working technologies require the simultaneous solution of three large problems--selection of suitable sensors, design of an effective control strategy and the realization of these in the machine tool.

Robots

The third section dealt with robotics, which at this time promises the greatest novelty in material handling and machining processes and which is being researched and developed with significant resources in the developed industrial countries. Before the section session Academician Tibor Vamos gave a summary presentation titled "Research Work in the Area of Intelligent Robots and Their Possible Applications."

The speakers reported on practical industrial applications. Soviet and West German authors analyzed computer methods which can be used in designing robots together with proposals for practical solutions (N. A. Lakota, J. I. Rassadkin and V. A. Chelishev in "Computer Design of Control Systems for Industrial Robots," A. M. Ivkin, V. B. Kurdyashov and N. A. Lakota in "Use of a Self Guiding Principle in Designing an Adaptive Control System for Robots" and U. Scmidt-Streyer in "Interactive Computer Design of Robot Applications"). The first two presentations dealt with design of robots while the last dealt with an analysis of criteria for their use and selection, with their optimal location and with an evaluation of alternative solutions.

Some presentations illustrated concrete, goal-oriented developments. For example, the paper by Laszlo Mero, Dmitrij Csetverikov and Miklos Bathor titled "A Two-Dimensional Recognition System for Autobus Panels" reported on an identification

HUNGARIAN SPEAKING COMPUTER IN LABORATORY STAGE

Budapest SZAMITASTECHNIKA in Hungarian Dec 80 pp 4-5

[Article by Gabor Kiss and Gabor Olaszy: "Artificial Speech With a Computer"]

[Text] In our previous two articles we reported on the history of the production of artificial speech and gave a few foreign examples of the application and utilization of speech synthesized by a computer. This time we will report on the work which has been underway since 1973 in the phonetics department of the Linguistics Institute of the Hungarian Academy of Sciences, under the leadership of Dr Kalman Bolla, candidate, work being done by the authors with the cooperation of Peter Nikleczy aimed at the production of artificial, synthesized speech. We will describe the hardware and software systems which we worked out in our laboratory for the artificial production of Hungarian speech. A good quality range of sounds can be produced with this system. In addition to basic scientific research on linguistics and phonetics there is also an extraordinarily broad range of possibilities for social and industrial applications.

The hardware parts of the system (figure 1) are a PDP 11/34 minicomputer and and OVE III speech synthesizer of Swedish manufacture. The OVE III is actually a filter system with variable characteristics which can be digitally controlled. It contains three basic circuits--filters to produce voiced sounds, nasal sounds and humming sources. An impulse generator activates the voiced sound and nasal sound filters; a noise generator activities the humming circuit. We control these circuits with the aid of 16 parameters (partly acoustical). Control can be manual with 12 two-position switches or digital with the computer. The input channel of the synthesizer is a 12 bit one, of which 4 are address bits to select the previously mentioned 16 parameters while the remaining 8 bits determine the internal value of the actual parameter. With manual control one can produce only isolated sounds (primarily vowels), which are continuous and have a constant acoustical structure in the course of generation. (Dr Kalman Bolla wrote an article about this titled "Acoustical Analysis and Synthesis of Hungarian Vowel Sounds" in issue No 1 of MAGYAR FONETIKAI FUZETEK.) A computer is needed to produce sounds which change a great deal when being voiced and to produce a dynamically changing speech process. The configuration of the PDP 11/34 computer (which we began using in the fall of 1979) is: a 64 Kbyte operational memory, two floppy disk units, an LA 36 console typewriter, a VT 55 alphanumeric display and an AD and DA converter. A 16 bit parallel interface provides a link between the speech synthesizer and the computer.

The FOPROG program developed by us and running under RT-11-FB constitutes the software for speech synthesis in our laboratory. Before we turn to a description of the program let us look at how computerized speech synthesis takes place! The goal when producing a continuous range of sounds is to imitate the quickly changing envelope curve of natural speech. With the aid of the computer we can approximate this continuous curve in discrete steps, with a series of microsections of time "t" (3-20 ms) which constitute the so-called sound segments. There are two paths to a solution. The first is to build up every range of sounds minutely treating them individually. We use this method for linguistic phonetic experiments. The other path is automatic speech production. The computer automatically carries out the synthesis of the text to be voiced--primarily in industrial or social applications.

In the first synthesis method we first determine the acoustical parameters of the range of sounds. Then we break up the range of sounds along the time axis into the previously mentioned sound segments so that the break points of the intensity and frequency courses determined by the parameters always fall at the boundary of two segments. We provide the sound segments with an identifier having a maximum length of six characters. In the second step we put the sound segments into the computer in such a way that we can list the values of the parameters making up the sound segments according to the identifiers. (If the parameter is constant, one value is enough.) The third step is for the computer to break down every segment into a series of micro-segments of time "t" and to calculate the mean value of the parameters in the micro-segments. In the fourth step the computer communicates to the OVE III the parameter values of the micro-segment series in the segments of the range of sounds to be synthesized so that each micro-segment will be sounded for time "t". If the time "t" is short enough the range of sounds produced will sound continuous even though it is composed of static parts of time "t". (Just as in a motion picture the movement is produced from a series of still pictures, so we build up a dynamically changing speech process out of short constant sound parts.) We built the FOPROG program, which does what was described above, in several steps, writing it in the FORTRAN IV--PLUS and MACRO 11 language. At present we can synthesize a range of sounds lasting 2.5 seconds with a single run.

The operation of the program can be controlled in the interactive mode with the VEZ control language developed for this purpose. This language consists of 18 instructions. They synthesizing system can be handled flexibly with the VEZ control language because the instructions include input, data movement, time manipulations, output and documenting commands. Each command consists of a three letter instruction name and a parameter list which are first read into the computer as a series of characters; then a syntactic interpreter breaks down the series of characters into its elementary parts. The list which can be seen in figure 2 shows the creation of the synthesized range of sounds for "E's?". [Pronounced "Aysh" and meaning "and".] The RUN command is followed by a time manipulation instruction (IMI). With the aid of this we determine the speed at which the range of sounds will be voiced, which could be one-tenth of or even 10 times the natural pronunciation. (Normal pronunciation corresponds to 100.) This is followed by the entry (BEA) of the parameters figuring in the E'1 and E'2 slices of the sound "e". Then, as a result of the JON instruction, the computer enters into operational storage from the data bank, which we store on floppy disk, the E'S which realizes the transition between the "e" and "s" sounds and the S1 and S2 sound segments which produce the "s". With the ETI instruction we add the sound segments in operational memory to the list and provide them with the common "hashmark" ES identifier. We have thus produced the range of sounds "es". After the play instruction (LEO) the now completed E'1 and E'2 sound segments are stored (MOR) and we stop the program with the instruction VEG. With this system one can reproduce natural speech with great precision.

The second synthesizing method is automatic speech synthesis. As we mentioned in our preceding article, for a long time written texts (program languages, output lists) mediated in the machine-man and man-machine communication chain. It would be very convenient for the user if he could use human speech as the mediator. We examined the machine-man link in the above communication chain and worked out the basis for a system providing computer output spoken in the Hungarian language. In the first stage of realization the system is suitable for "speaking" only numbers. We could use this capability when checking data input, to communicate the results of a calculation, etc. The module providing the voice output first breaks down the actual number into a series of syntactic units. Then as a voicing of it is needed a series of sound segments, existing in operational storage, corresponding to the syntactic units is communicated to the synthesizer. The number "becomes audible" as output from the synthesizer. This module is the basis for the putput of a system providing optional Hungarian language speech (thus not working with a dictionary with a limited number of elements). This synthesized speech is constructed by the computer out of basic sound segments in storage on the basis of linguistic rules fed to it.

8984
CSO: 2502

HUNGARY

HOLOGRAPHIC-ASSISTED RESEARCH IN ANALYSIS, DESIGN OF DISPERSE SYSTEMS

Budapest MUSZAKI ELET in Hungarian No 6, 20 Mar 81 p 4

[Text] Holography permits the development of new procedures for making measurements. On the basis of these it becomes possible to arrive at improved designs, constructions, and many qualitative parameters can be improved as well. Research in this field has been conducted for a number of years in Hungary, in the chemical industry, for example, and results which have been patented in several developed countries have been achieved.

Information on this work was provided by Dr Judit Jozsa of the Technical Chemical Research Institute [Muszaki Kemiai Kutato Intezet] of the Hungarian Academy of Sciences;

(The new method of taking measurements, developed at the Institute and successfully applied in several fields of industry, makes possible determination of the average size of disperse systems (drops, bubbles, grains of powder) in chemical procedures without interference in the process itself. It provides information on distribution of particle by size, spatial relationship and reveals anomalies such as agglomeration, fragmentation, etc. The hologram helps record such information in the entire area under investigation.

"The selected area is illuminated by a pulsed ruby laser. Exposure time is 20 nanoseconds, which permits recording of very ephemeral events. The special advantage of three dimensional presentation is that the area can be studied from all angles and there is no depth distortion.

'When the information has been reconstituted, it is possible to photograph the particles from any plane. After the appropriate degree of greyness has been selected for contrast purposes, the picture can also be evaluated by electro-optical means.

"Essentially, the patented procedure of our institute produces two holograms simultaneously on a single holographic plate. The exposure recorded in this way can be reconstituted in two ways. This makes it possible to select the optimal arrangement of a series of industrial measurements having changed parameters on the basis of the first hologram.

"We have used our method to make many kinds of investigations in the chemical industry and were able to prove results undeterminable through traditional measurements. One example is the sedimentation of dense industrial suspensions in connection with which Dr Tibor Blickle, our director, worked out a new theory. Whereas the traditional theories of sedimentation are generally based on the behavior of a single grain, the Blickle model describes the rate of sedimentation of the entire quantity of dense suspension actually present in industry. Through holography, it was possible to prove that the rate of sedimentation of the entire volume is constant regardless of the size of the particles. This has been of use in determining the time required to purify sewage and has resulted in substantial technical and economic benefits.

"Another successful application of holography was in designing atomizing jets for oil-burning furnaces. Irregular operation of such jets wastes fuel. Therefore, we sought to discover the relationship between the geometry of the jets and the oil droplets formed in the course of operation. Through our holographic measuring methods, we succeeded in determining the optimal design for the construction of atomizing jets.

"The method can be put to good use in many other branches of industry, especially in technological operations where the characteristics of dispersion need to be studied in their proper spatial relationships at the moment of their formation.

CSO: 2502

MOST IMPORTANT SCIENTIFIC ACHIEVEMENTS DESCRIBED

Warsaw ZYCIE WARSZAWY in Polish 6 Jan 81 p 6

[Text] The year 1980 revealed also many weaknesses in Polish science and technology that have been accumulating for years and have been futilely discussed for many years; the nature of these weaknesses was moral, ethical, material, and organizational. Because of the heightened crisis in Poland last year, there were no especially noteworthy discoveries and breakthroughs in science and technology which are indissolubly linked to other spheres of social and economic life.

Nevertheless the works of many scientists and teams or researchers, engineers and designers produced interesting results which extend the limits of human knowledge, expand our science, and have a useful application either today or in the future with the hope for considerable economic results.

A team of scientific-technical journalists of the Polish Press Agency traditionally presents a list of those achievements in Polish science and technology that, in their opinion, were the most interesting.

The team, which is directed by Prof Stanislaw Kontureka from the Institute of Physiology of the Nicolaus Copernicus Medical Academy in Krakow, explained certain aspects of the cyto-protection mechanism, that is, the ability of the mucous membrane of the digestive tract to resist the harmful effects, for example, of certain foods, medicines and various kinds of chemical substances.

The Krakow scientists began last year to study the function in cyto-protection of the auxo-peptide, i.e., the so-called epithelium growth. The research conducted by Prof Konturek's team is potentially of great importance for the prevention of damage to the mucous membrane.

The first out-patient cryo-therapeutic equipment was constructed last year in the Medical Technology Main Center's [COTM] division in Bialystok. The equipment was designed by the [COTM] Institute of Low Temperatures. The research and design work conducted by the Institute of Low Temperatures provides extensive application of cryo-surgical methods in clinical medical practice, general surgery, dermatology, gynecology and otolaryngology.

The cryo-therapeutic equipment of COTM is used by the Institute of Oncology in Warsaw, the Medical Academies in Warsaw and Krakow, the Wolski Hospital in Warsaw and other centers. The effects of cryo-therapy, which now could be applied in smaller out-patient clinics, include painlessness and the absence of bleeding (especially important in oncological surgery), the possibility of performing safe surgery on heavily blood-supplied organs, such as the liver and kidneys, and minimization of post-operative scars.

Magnetic semiconductors were discovered by Polish scientist six years ago; magnetic polaron in "semi-magnetic materials" was discovered by Docent Jan Gaj, Dr Michael Nawrocki, prof Jerzy Mycielski, Dr Andrzej Mycielski, and Dr Tomasz Dietl, who are physicists at the Institute of Experimental Physics and the Institute of Theoretical Physics at Warsaw University and the Institute of Physics of the Polish Academy of Science.

The concept "polaron"--the quasi-particle which emerges during the motion of an electric-charge carrier and polarizes the electric and megnetic qualities of its environment was known to physics of magnetic materials. The merit of the scientists in this case was the discovery of identical phenomenon in a new class of materials.

As a result of the cooperation between the specialists of the Institute for Construction Technology, the Central Laboratory for Radiation Protection, the Institute for Radio Electronics of the Warsaw Politechnical School and the Institute for Nuclear Technology "Polon," methods and equipment for the measurement of natural radioactivity in construction materials were developed.

This development is of great importance for the protection of the human environment. The newly designed equipment, which is already in production at "Polon," provides a fast and precise evaluation of materials used or to be used in the construction industry. In conjunction with the indispensable measuring equipment, suitable standards were developed that should eliminate the discrepancies between regulations and activities. There is therefore, a possibility of protecting human health and also utilizing in a rational way building materials, including those obtained from a variety of industrial waste materials.

The Polish plastic-shaping school, which is well known in the world for the method of forming the rocking die developed by Zdzislaw Marciniak the multi-purpose presses developed by Edmund Nowak, and the drill mills developed by Mieczyslaw Olszewski, was enhanced during the past year by the design of the PSHT 250 twin screw presses for stamping and forging. This design was developed according to the concept of Jozef Poczobut and Robert Zebrowski at the Center for Research and Development for Plastic Shaping of Metals "Plasonet" in Warsaw.

Due to the heretofore absence of a design which reduces the forces occurring in the body of the press, the press is many times lighter than similar designs in the most industrially advanced countries in the world. The novel design makes it possible to operate the press without the traditional special foundations which considerably increase the investment cost; installation of this press on only anti-vibration cushions is sufficient.

Meaningful results were achieved in Poland in work on microprocessors. This equipment is functionally related to computers but is only capable of using, on a large scale computerized-information methods of control, management and inspection.

In view of their broad application, beginning with scientific research, various sectors of technology (energy, transport, measurements, navigation) and including equipment for everyday use, the world-wide interest in microprocessors and their application is very great. This is followed by the expansion of research, but its results, technical details etc, are not being disseminated. The research and the development of a configuration for a microprocessing system that was conducted by the Institute for Electronics Technology of the Scientific Production Center for Semiconductors in Warsaw provides the capability for developing domestic production of modern computerized information systems.

Cooperation between the electronics plants "Lamina" and the Radiation Chemistry Plant of the Institute for Nuclear Research in Warsaw resulted in new radiation technologies for modification of semiconductor materials. The following was developed: technology for producing fast-switching semiconductor diodes; modification through radiation of new types of thyristors (electric power rectifiers) etc. Guidelines were also prepared for a special section of radiation technology (that includes a linear accelerator for the "Lamina" plants).

For the first time in the CEMA countries, the technology for the production of fast thyristors was developed. This meets the needs of manufacturers of electrical converters in their most advanced types. The novel Polish method of modification through radiation of the structure of semiconductors ensures at the same time a much more precise construction of diodes and thyristors in comparison with the diffusion methods applied up to this time.

The general use of fast switching diodes and thyristors in electric power equipment should in the future result in considerable energy savings.

The Institute for Precision Mechanics [IMP] developed a new type of tool steel (identified by the symbol WMW-1) which was placed in use at the Mechanical Plants "Ursus." This new material is lighter and cheaper than the one previously used. Tools produced from that steel are six times more durable and 40 percent cheaper.

The steel is produced in Poland primarily from imported ore, but the prices of alloy additives (of which there is less in the new steel) have, in recent years, increased many fold. This is the reason, among others, that the work conducted by specialists from IMP is important. The introduction into industry of new types of steel makes it possible to use this basic structural material efficiently; this is important to the extent that steel-intensiveness in the national economy is still too great. Rapid practical application of the research results should be emphasized. Heretofore, industry has not always been interested in new and cheaper materials, even if, from the viewpoint of their utilization, they were better than the more expensive materials.

The scientific research conducted by Prof Andrzej K. Tarkowski of the Institute of Zoology of the University of Warsaw resulted in the development of experimental embryology of mammals.

The purpose of the research conducted by the professor and his team is to understand the developmental mechanisms which are active during the early period of embryonic development of mammals and the effects of certain disturbances which occur during this period. During the past few years the focal point of research has shifted to the problem of the effects of the cytoplasmic-nucleus during the period of maturation of the ovum cell and in the early period of embryogenesis.

The State Publishing House for Scholarly works (PWN) published Dr Andzej Paczkowski's work entitled "The Polish Press in the Period 1918-1939." This work is the first synthesis of the subject of the Polish press of that period and is distinguished by its literary, cognitive, and didactic values.

The work, which is primarily the result of research conducted by the author himself on the still little-known interwar period in regard to the functioning of the press in Poland, contains many descriptive facts and a large amount of very descriptive, i.e., the most historically valuable, material.

Those fragments, in which the author discusses the problems relating to the development of the journalistic profession, the organizing of press agencies, and the status and evolution of the press of national minorities resulting in the Polish Republic, are very valuable.

This work is a volume in a series entitled "History of the Polish Press"--a synthesis of the development of journalism in 19th and 20th century Poland that is being prepared by the Institute of Literary Research of the Polish Academy of Science (PAN) under the editorship of Docent Jerzy Lojek.

2570
CSO: 2602

END

END OF FICHE

DATE FILMED

21 April 1981